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WEST AFRICAN PRODUCTION AND EXPORT PROSPECTS FOR PALM OIL AND PALM KERNEL OIL TO 1980

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FOREWORD

This is the first of a proposed series of studies reviewing foreign competition for U.S. vegetable oilseeds and products. Palm oil production and exports are rising rapidly and plans call for further, sharp increases. The purpose of this report is to review recent developments related to African palm oil production and export prospects through 1980.

The author visited major African palm oil producing regions in late 1971. He is deeply indebted to the continuing assistance of the U.S. Agricultural Attaches and other U.S. Embassy personnel in the areas visited. In addition, the author has drawn extensively on other publications, written by Dr. Eric R. Berg, Alan Holz, W. S. Hartley, A. C. Zeven, Malcolm J. Purvis, and Peter Kilby.

Howard A. Akers, Director
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CONTENTS

Page	
1	Summary
2	Introduction
2	Background
3	Nigeria
4	Republic of the Zaire
5	Dahomey
6	Ivory Coast
7	Market analysis
7	Oil palm background
8	Major world production areas
9	Characteristics and uses of palm oil and palm kernel oil
9	World trade patterns in oil palm products
10	West African production
11	Production trends
20	Production practices
22	Palm fruit processing industry
22	Processing techniques
25	Palm industry structure in major producing countries
27	Marketing
27	Subsistence marketing
27	Export potential, 1980
30	Appendix

WEST AFRICAN PRODUCTION AND EXPORT PROSPECTS FOR PALM AND PALM KERNEL OIL TO 1980

By John Lynam

Summary

Production of palm oil is expected to boom during the current decade and world exports, virtually stagnant during the 1960's, could reach a level almost triple that of 1970. These increases will result from large expansions in the planting of high-yielding oil palms on plantations in West Africa and Southeast Asia.

Because of the expected upsurge in production resulting from increased plantings in West Africa, this decade should see a reversal in the trend of declining commercial production. Exports from this area should increase to about 350,000 tons by 1975 and to 400,000 tons by 1980.

In 1960, Nigeria was the world's largest exporter of palm oil, supplying 186,000 tons or over 30 percent of total world trade. By 1966, however, a growing population had siphoned off increasing amounts of oil to meet its consumption requirements, and exports dropped to 146,000 tons. In 1967, the country's civil strife almost completely terminated this trade.

Domestic requirements are expected to continue to siphone off Nigeria's increases in palm oil production so that by 1975—when output should be back to its prewar level—exports will probably not be more than 40,000 tons. Through the latter half of the decade Nigeria's major concern will be to supply its own domestic needs.

Like the trend in Nigeria's palm oil exports, those from the Zaire peaked in 1960, reaching just under 170,000 tons. From this level they declined steadily through the sixties.

In the 1964-67 period, political instability in the Congo and resultant civil strife caused the movement of smallholders out of production of palm oil for the commercial market and a halt in new plantings of palm seedlings by plantations.

The Zaire's commercial production of palm oil, based almost entirely on plantation operations, has recovered from the low levels of the 1965-66 period and has stabilized since 1968 at around 175,000 tons.

Exports, although reaching 141,000 tons in 1968, dropped to 111,000 tons by 1971 as a result of increased domestic industrial utilization.

The Zaire's palm oil industry, on the whole, appears to be in a state of stasis—plantations are trying to maintain production while not making large investments in expansion.

There is little potential for increased production of palm oil in the Zaire in the near future, and exports are expected to undergo a moderate to sharp drop through the 1970's. Because of the current crop of problems facing producers in the Zaire, it would probably be among the first countries to shift out of palm oil production as a result of increased competition in world markets.

Though a relatively minor exporter of palm oil in the past, Dahomey is expected to expand foreign shipments to 60,000 tons by 1980, five times its present level. Much of this increase will come from 67,000 acres of high-yielding oil palms planted in three large plantation projects during the 1960's.

The Ivory Coast is expected to become the largest exporter of palm oil from the African Continent by 1975, after having been a net importer up to 1969. The increase will come as the result of a planting program begun in 1964. By the end of 1970, over 165,500 acres had been planted to high-yielding palms. The total will reach 239,700 acres by 1975, and go to 338,500 acres by 1980.

Until 1970, the Ivory Coast had only three small private plantations which produced some 15,000 tons of palm oil annually. Imports were necessary to

supplement this supply. The new plantings, which started coming into production in 1969, boosted oil output to 21,000 tons; by 1970 it reached 42,000 tons. Production is projected to increase to 170,000 tons by 1975 and to 250,000 tons by 1980.

Exports of palm Oil from the African Continent reached their peak of just over 400,000 tons in 1960—the year most African countries achieved independence. Since then, however, exports have declined consistently, reflecting boosts in domestic consumption, a lessening of operational efficiency resulting from the withdrawal of colonial administrators, lack of a continuing investment program because of the area's general political instability, and production disruptions owing to civil unrest.

African exports reached their lowest point in 1967 when, as the result of the Nigerian civil war and the Zaire disorders, they settled at 172,000 tons. They remained stabilized at that level through 1970.

Western Europe was the major market for palm oil during the 1960's. Imports into the area averaged 430,000 tons during the period 1960-69, about 75 percent of total world exports. The European Community was the largest importer, taking an annual average of 275,000 tons; the United Kingdom was next with an annual average of 130,000 tons.

Palm oil sales to all major markets jumped dramatically during 1971. Imports into the United States increased from 64,000 tons in 1970 to 103,000 tons 1 year later, the highest level of U.S. palm oil imports since 1941. Imports into the United Kingdom in 1971 should be about 50 percent higher than in 1970—up to 210,000 tons—and those in the EC are expected to increase by 30 percent to just over 400,000 tons.

With increasing exports of palm oil going into the world market, the price spread between palm oil and other major vegetable oils has widened considerably. For example, soybean oil prices in 1970 (c.i.f. Europe) were $31 per ton higher than for palm oil, compared to an average difference of only $11 per ton in the 1960-69 period. By 1971, the difference in prices had risen to an average of $47 per ton because of increased supplies of palm oil. This large price differential could be maintained throughout this decade as palm oil attempts to enlarge its share of the world fats and oils market.

Total West African palm oil exports, though growing, will supply a diminishing share of trade in this commodity in the present decade. By 1975, West African exports will amount to a little over 15 percent of world trade, down from the 1970 level of 25 percent, and the much higher 1960 level of 66 percent. West Africa's palm oil exports will continue to be directed to the EC market because of the duty preference there.

Introduction

Exports of palm oil from the African Continent have declined from just over 400,000 tons in 1960 to 182,000 tons in 1970. This decline has been due to two primary factors: increased domestic consumption and civil strife in the major oil palm areas in the two main producer—exporter countries, Nigeria and the Republic of the Zaire. Therefore, to meet the rising domestic demand for palm oil and also to diversify agricultural cash crops, many countries in West Africa have embarked on large programs of expansion in oil palm plantings. The nature of these two diverse trends is the major focus here to get an idea of prospects for future exports of palm oil and palm kernel oil from the African Continent.

Background

The oil palm, *Elaeis guineensis*, is indigenous to West Africa, with natural stands occurring along the coast within a 300-mile-wide belt from Senegal to Angola. The areas suited to cultivation of palm oil are illustrated in fig. 1. In addition, there have been extensive plantings of higher yielding palms in plantations in the Zaire, Ivory Coast, Dahomey, and Cameroon, as well as smaller planting projects in Sierra Leone and Liberia.

Palm oil is a major component of food consumption in the tropical-forested regions of West and Central Africa, and is generally consumed in a crude state. In the urban areas, there is substantial demand for palm oil for use in the manufacture of margarines and soups, and to a lesser extent, in shortenings and table oils. Beyond this, palm oil in many of the West and Central African countries is a large agricultural export and a large foreign exchange earner. Therefore, two large and mutually exclusive production and marketing systems become visible in most major producer-exporter countries: one is the rural-subsistence market; most of the other is the commercial export system which produces for industrial needs and for

exports. Also, a small portion filters down to the local urban markets.

Most of the inhabitants of the rural areas produce enough palm oil to meet their needs. The fruit is generally gathered from wild palms and processed by traditional methods in village compounds. Any surplus is sold on local outdoor markets or may be transported to the outlying urban areas by small middlemen who sell it in its crude form.

In most exporting countries the palm oil is supplied primarily by plantation production, with a smaller amount supplied by producer cooperatives organized around a central mill. This yields a much better quality oil with a lower free fatty acid (FFA) content than that produced in the subsistence sector.

Nigeria, however, stands in a unique position, in that it has organized a marketing system capable of exporting surplus oil from the small holder. This is due to two factors: (1) wild oil palm stands are dense enough to produce a surplus; and (2) the quality was controlled by a system of State-owned Pioneer oil mills, distribution of hand-operated presses to villages, and a State marketing system whereby licensed buying agents were set up to buy surplus oil from the smallholder producer.

Nigeria

In 1960, Nigeria was the largest exporter of palm oil in the world, exporting 186,000 tons. Exports consistently declined from this level through 1966, as the growing population siphoned off more to meet its consumption needs. In 1967, exports were almost completely stopped because of the civil war which caused the disintegration of the marketing system, the unsettling of the population, and the destruction of much of the processing capacity in the large oil palm producing region in the three States of the Eastern Region. Since the war's end in 1969, annual exports have not exceeded 10,000 tons.

Though statistics on production, consumption, and acreage are almost nonexistent, the following observations were made:

1. Since the war, the former Eastern States Marketing Board has been broken down into three separate marketing boards. It was only in 1971 that the three boards began to function properly, particularly in financing enough licensed buying agents (LBA's) to handle the production areas.

2. Processing capacity was severely damaged during the war. It is estimated that of the 67 Pioneer oil mills in production before the war, only 26 have been rehabilitated to the point that they are now in working order. It is unknown how many of the hand presses were either abandoned or destroyed. Consequently, the extraction of the oil from the fruit is now primarily done by a traditional method, the so-called canoe method. This results in a lower extraction rate (about half of what may be obtained from a Pioneer oil mill) and a generally higher FFA content oil.

3. Food prices have risen dramatically in Nigeria since the war, in some instances rising to 3 times their prewar price. Domestic prices of palm oil on the local market have followed this pattern to the point that local market prices are substantially higher than the basic producer price that the LBA's are authorized to pay.

4. Industrial utilization of palm oil is estimated to be about 35,000 tons, primarily for the manufacture of soaps and relatively smaller amounts of margarines. There are three soap manufacturers in Aba and one soap and margarine manufacturer in Lagos. All buy their oil from the marketing boards, and for the past 2 years the oil has been extremely high in FFA content, about 18 percent.

5. Most of the population in the Eastern Region that evacuated their lands during the war have resettled. But, because of the lack of maintenance of the palm trees during the war years, it is estimated that its yields will not return to normal until 1973.

6. In the Eastern Region, there has been a substantial recovery in the purchases of palm kernels by the marketing boards, without a proportionate recovery in the purchases of palm oil. Marketing of palm kernels stored during the war with the recent return to normal of LBA activity in these regions may be the cause of the recovery.

7. Visible Government plans for rejuvenation of the oil palm sector are practically nonexistent. Most State governments are concentrating on repairing the rather dated Pioneer oil mills. Because of difficulty in finding parts and lack of financing, however, these are proceeding slowly. There have been minor oil palm seeding distribution projects, but these will have small effect on export potential. Also, the State marketing boards are taking no initiative to raise the basic producer prices for purchases of palm oil and palm kernels.

8. During the war there was a substantial resettlement of the Ibo population back into the Eastern Region, estimated at 2 million people. This resulted in a substantial increase in consumption of palm oil in this region.

A synthesis of these observations leads to the following conclusions. Production of palm oil in the Eastern Region is recovering, as witnessed by the increasing purchases of palm kernels by the Eastern States Marketing Board to 60 percent of the prewar normal in 1971. The proportion of oil to kernels produced, however, will be somewhat lower because of the necessity of resorting to less efficient processing methods resulting in a somewhat lower recovery in palm oil production. Also the FFA content produced as a percentage of the total will tend to be below 5 percent. This recovery in palm oil production is being siphoned into domestic consumption rather than to the marketing boards, as the producers obtain a much better price selling their surplus on local markets or to small middlemen than to LBA's at the basic producer price. The very high FFA content oil that is virtually unsuitable for edible uses then is sold to LBA's. The palm oil that can be directly controlled by the marketing board is that relatively small amount produced on a few small estates and by the functioning Pioneer oil mills.

Production should recover to the fullest extent possible by 1973-74, as the trees recover from their lack of maintenance (primarily pruning) during the war years. The high domestic prices now compared to the prewar prices seem to indicate a continuing deficit in domestic consumption requirements that could absorb the further recovery in production. Added to this are domestic industrial requirements for oil of some 35,000 tons that must come out of marketing board purchases. Therefore, estimates show that Nigeria will not be exporting more than 25,000 tons by 1975, and that afterwards Nigeria will be concerning itself with producing for its own domestic needs.

Republic of the Zaire

Much like Nigeria, exports of palm oil from the Republic of the Zaire (formerly Democratic Republic of the Congo) have declined from their peak of almost 170,000 tons at the time of independence in 1960. This has been due to three primary factors: (1) The political instability and resultant civil strife caused major disruption in the major palm producing areas from the period 1964-67, resulting in; (2) The movement of the Zarians small holder out of production of palm oil for the commercial market and the cessation of new plantings of palm seedlings by plantations; and (3) Although relative political stability of recent years has brought about the return to production of the major plantations, many have been forced to abandon large acreages because of lack of sufficient labor for harvesting and maintenance operations. The labor shortage has been caused by the movement of the younger males out of the rural areas, the low wages, and refusal of most laborers, preferring to work on the ground rather than climb the taller palm trees.

Commercial production of palm oil has recovered from the low levels reached in the 1965-66 period to a plateau of about 175,000 tons, which it has sustained since 1968, resulting in exports of 141,000 tons in 1968 and dropping to about 120,000 tons in 1971 because of increases in domestic requirements. Commercial production of palm oil by small Zarian producers has almost disappeared as supported by the drops in shipments of palm oil through Kinshasa in barrels (as opposed to the bulk shipments of plantations) from 34,638 tons in 1959 to just over 5,000 tons in 1970. This has resulted in the increasing concentration of commercial production in large plantations, which are primarily foreign owned. The two largest plantations in the Zaire, P.L.Z. and Societies cultures, now account for over 50 percent of total production.

One other distinction in production sources may be discerned. There are basically two major production areas in the Zaire, both operating under different circumstances. One is primarily located in the Kwilu District around Kikwit and the other is located primarily along the Zaire River and its tributaries.

Production, around Kikwit, depends primarily on the wild palm groves in the area. Generally, there is a small area of plantation palms with a central mill and vast areas of wild stands in the outlying areas. This is the original area of the palm industry in the Zaire and there have been few basic changes or improvements here since the original investments in the early part of the century. In recent years there has been increasing difficulty in keeping the mills at full capacity, as there has been a growing reluctance of labor to harvest the trees. This is compounded by the added inefficiencies of maintaining an extensive road system, processing lower oil-content dura fruit, and producing a lower quality oil because of the greater time lag between harvest and processing. Efforts to increase efficiency of late by planting of higher yielding varieties have failed because of failure of the seedlings to respond to the relatively longer dry season in this region. With increasing Government taxes and raises in minimum wage rates, these areas are becoming very marginal and are only capable of producing because of the current high world price level.

The main producing region consists of the large plantations located primarily along the Zaire River and its tributaries from Lisala to Kisangani in Haut-Zaire and Equateur Provinces. Here the climate is more suitable to the higher yielding varieties and operations tend to be more efficient. The capacity of this region, however, also is limited by labor problems, and many plantations have been forced to abandon extensive acreages of older trees, concentrating on younger, higher yielding plots that can be harvested from the ground with Malayan knives. There has been no expansion in this region since independence because of political uncertainties and labor limitations. Since 1969, however, P.L.Z. has embarked on a program of replanting about 600 hectares per year at two major plantations, with prospective yields at maturity of 3 tons of oil per hectare. This is not intended to be extensive, as there are no plans for increasing processing capacity which was all installed prior to independence.

One other factor weighs on the ability of this region to produce for the world market: The Zaire is the only palm oil exporting country that has a high internal transport cost to bear in the cost of production. Palm oil must be moved in some instances more than 1,000 miles down the Zaire River by bulk barge to Kinshasa. There it is loaded onto railroad cars and transported to the port facilities at Matadi. Palm oil being loaded from storage tanks to rail tank cars is shown in fig. 3. Shipping cost from bulk tanks at the plant to the tanks at Matadi are estimated at a little over 12 Ƶ ($24) per ton and are rising each year. This is just a little less than what it costs to ship palm oil from Matadi to Europe, and at the low price levels such as occurred in 1968, Zairian producers had a difficult time meeting costs. Finally, domestic requirements outside that in the rural-subsistence sector which takes care of its own needs have been rising each year since 1966. These are primarily requirements for industrial utilization—soap, margarine, table oil, and as a solvent in the flotation process in the expanding copper industry. A small amount is distributed to wholesalers for the local markets in Kinshasa. In both Kinshasa and Shaba (Katanga) there are plans to expand production capacity for soaps and margarines. In addition, the expanding copper industry in Shaba is consuming an increasing amount. Finally, the population of Kinshasa has been increasing rapidly each year generating added requirements.

The means of allocation to the domestic market as opposed to exports are very arbitrary and create distortions in the marketing system. The price for palm oil sold on the domestic market has been fixed at 62 Ƶ ($124) per ton. Because this is way below the world price and is even below the producer's cost of production, the government regulates how much shall be diverted for domestic requirements. This amount has increased from 27,150 tons in 1966 to 47,088 tons in 1970. A reflection of the price distortion is that palm oil sold to wholesalers at 7.5K (100K = 1 Ƶ) per liter bottle is sold on the local retail markets where there are no effective price controls at 20K. Additionally this has become another added cost the producer must absorb, and it becomes a question of what percentage of his production can be absorbed at this price.

In summary, there is no potential for increased exports of palm oil from the Zaire in the near future, and it is expected that there will be a moderate to large drop in exports depending on world price levels up to 1975. If prices should fall below $200 per ton for an extended period, it is probable that firms in the Kwilv District will be forced to cease operations, necessitating a reduction in production of 35,000 to 40,000 tons. In the event this does not occur, exports by 1975 should be near 100,000 tons, as a result of the stabilization in production and increases in domestic requirements.

Dahomey

Though in the past a relatively minor exporter of palm oil, Dahomey is expected by 1980 to expand exports to 60,000 tons, 5 times its present level of just over 12,000 tons. Under the direction of a newly formed Government company SONADER, Dahomey began in 1963 the planting of large acreages of oil palms in three basic large plantation projects. Plantings averaged about 1,500 hectares per year till 1968 and from 1968 to 1970 about 4,000 hectares per year. By the end of 1971, the projects will have been completed, according to plan, with a total area planted of 27,000 hectares. Future plans call for another 6,000 hectares to be planted in the period 1973-75.

The projects have been financed by development aid from the International Bank for Reconstruction and Development (IBRD), European Community Development Fund (EDF), and the French developmental aid fund (FAC). The plantations thus are Government owned and actually organized as cooperatives. Generally in each block of oil palm plantings there is an equal area provided for the production of food crops and between the two areas, central housing is constructed. Laborers are paid a basic daily rate of 125 CFAF (U.S. $0.50) per day and eventually it is planned that excess profits will be distributed back to these laborers.

The processing of the palm bunches is handled by another Government-owned company SALAADA.

The company operates from palm oil mills with a total annual capacity of 140,000 tons of bunches per year. Up to the past year, these mills handled primarily bunches harvested from wild groves by small farmers. In 1971, another mill, with an eventual annual capacity of 50,000 tons, was put into operation at one of the plantations. Finally, two more mills are to be constructed at the two remaining plantations, each with capacities of 40,000 tons of bunches per year. SALAADA also operates one palm kernel crushing plant which produces about 24,000 tons of oil per year.

All the oil that is processed through these mills is exported. There are no industrial requirements for palm oil in Dahomey. The palm oil locally consumed is produced from wild groves by traditional methods. This is estimated at about 40,000 tons per year.

In summary, Dahomey in an effort to modernize its agricultural sector and increase foreign exchange earnings has just completed a successful oil palm expansion program. Exports of palm oil should reach 40,000 tons by 1975 and 60,000 by 1980.

Ivory Coast

The Ivory Coast is expected to reverse its position as a net importer of palm oil in 1969 to become the largest exporter on the African Continent by 1980. This has been the result of an ambitious and well-magaged oil palm planting program begun in 1964. Its purpose was to diversify the cash crops in the Ivorian agriculture, with its historical dependence on coffee and cacao. The projects would also have the added benefits of expanding export earnings, increasing industrial expansion, and providing employment to a large segment of the subsistence sector.

By the end of 1970 over 67,000 hectares had been planted to oil palms with plans for 97,000 hectares to be planted by 1975 and 137,000 hectares by 1980. Up to 1970 the Ivory Coast had relied on the production of about 20,000 tons of oil derived from three small private plantations, experimental plantations, and the harvesting of wild palms to fulfill its domestic requirements. Production increased from 21,441 tons in 1969 to 42,463 tons in 1970 as the new plantings started to come into production. Production is projected to increase to 170,000 tons by 1975 and 250,000 tons by 1980.

Six oil mills have been constructed since 1968 with three more to be completed by 1973. A bulk oil facility was just completed this year and is now operating at the port in Abidjan. In conjunction with the expansion in production of palm oil, BLOHORN, the only industrial user of palm oil in the country, is expanding its oil refining capacity, with a view to supplying a regional market in West Africa with table oil, margarine, and soaps. The company increased utilization to 23,000 tons in 1970 from less than 17,900 in 1969. By 1975, the company expects to be refining 60,000 tons of palm oil.

The oil palm projects are probably the best organized and most efficient in all of Africa. The basic structure is a central plantation of about 4,500 hectares which is serviced by a mill. Then in a 20-kilometer radius from the mill, outgrowers in the various villages have been furnished with seedlings, fertilizers, pesticides, and technical help, and have planted about an equal hectarage to oil palms. The mill then sets up a weekly collection schedule for which the small holder is paid on a weight basis. Expected production of each village block is programed on a computer and actual receipts are fed in and correlated. When there is a discrepancy, a technical advisor is dispatched to the village block to correct the problem.

The mills employ the most modern technology available, capable of producing a high-quality oil with a free fatty acid (FFA) content of about 2.0 percent. With its duty exemption in the Common Market and the sizably lower freight rates to Europe, the Ivory Coast expects to be highly competitive with Malaysian and Indonesian exports.

The increase in exports from Africa compounded with the fast expanding exports from Southeast Asia will mean a large expansion in world trade in this oil, in direct competition with much of U.S. soybean oil in the European market, particularly that portion used in margarines and shortenings.

This expansion and the resultant increased price competition will bear most heavily on the palm oil industry in the Zaire because the industry operates under the inefficiencies of outdated technology and bears a large internal transportation cost. Also, the industry is almost wholly European owned and pays increasing taxes and other revenues to the Zairian Government. Should the price of oil fall below $180 per ton, as is highly likely, many of the smaller plantations will be forced to cease operation, unless the Government changes its policies.

Table 1.—African palm oil exports and projections to 1980
(1,000 metric tons)

Country	1960	1965	1970	1975[1]	1980[1]
Nigeria	186	152	9	20	-
Republic of the Zaire	169	79	123	100	80
Dahomey	16	13	13	40	60
Ivory Coast	([2])	([2])	12	100	170
Other African exporters	30	37	16	30	40
Total African exports	401	281	173	290	350

[1]Projected. [2]Less than 500 metric tons.

Market Analysis

Exports of palm oil from Africa are marketed almost totally in Europe, primarily in the Common Market (EC) and the United Kingdom, with very small amounts going to other African countries. Malaysian and Indonesian exports of palm oil find large markets in the United States, Japan, and Iraq, but still depend on the European market to absorb the major share of their exports. The African countries enjoy a slight advantage in freight rates to Europe as well as exclusion from the applicable duty (except for Nigeria) of 6 percent in the EC. This balances somewhat the edge Malaysia has in higher yields, and thus lowers production costs.

In the European market, palm oil is utilized increasingly in the manufacture of margarine. There are small amounts used in soaps, but palm oil has difficulty competing with tallow in this area. There is also some utilization in shortenings used primarily in the baking industry. In 1971, there was a large expansion in world exports of palm oil. This was absorbed primarily by increases in margarine production brought on by the rising butter prices in the Common Market and the United Kingdom. Under present conditions, the potantial for expansion of consumption of palm oil in the European market from the 1970 level of just over 500,000 tons is dependent on the outlook for increased margarine consumption.

Also, SOGESCOL, the large palm marketing company in Brussels, has just completed a contract to supply Iraq with 100,000 tons of palm oil in 1972. With a continuing strong market for margarine in Europe and increasing imports of palm oil into the United States, the market for palm oil through 1972 appears to be strong. SOGESCOL expects the price to drop slightly from its current very high level to about $210 per metric ton for 1972.

Oil Palm Background

World trade in palm oil began in earnest in the mid-19th century, right at the beginning of the Industrial Revolution in Europe. Up to this time, only small amounts of palm oil were used in the production of soap, the consumption of which increased dramatically with industrialization. A new process was developed at this time for the treatment of fatty acids, which led to the use of palm oil in producing stearic candles. Then in the 1870's palm oil found a market in the production of margarine. This increase in demand for this palm oil coincided with the transferral of the shipping industry out of the slave trade into more legitimate trade, which made room for increased shipments of palm oil.

The supply during this period depended on native production from natural groves in West Africa, primarily Nigeria. By the early 1900's, however, it was realized that this source could not meet the increasing demand. By 1911, the first large commercial palm plantation was started in Sumatra by Belgian interests. By 1930, the palm industry was well established in both Sumatra and Malaya. Belgian interests in the Central Congo in the 1920's, following the example of the Far East, found it more profitable to establish plantations than exploit the natural palm stands. This set the pattern of world exports until the era of African independence in 1960.

With the disintegration of the colonial structure following World War II, many newly independent states in the tropical areas found the oil palm to be a logical alternative in their agricultural development plans. With development of high-yielding genetic stock, many countries developed combinations of plantation and small-holder planting schemes. In terms of development, tropical agriculture offers a few economic alternatives, the most common being tropical fruit and tree crops. In climates where the oil palm can be cultivated most profitably—that is, with average annual rainfall of at least 80 inches, evenly distributed throughout the year, constant sunshine at least 5 hours per day, and a mean maximum temperature of 85° to 90°F. and a mean minimum temperature of 72° to 75°F.—there are few, if any, crops that can compete with the oil palm. In jungle areas, the oil palm serves to widen the money sector of the economy, introducing subsistence farmers to the commercial sector. In addition, a processing industry must be established in the production area in which there is a great variation in the complexity of the processing technology (see Palm Fruit Processing Industry), depending on the ratio of capital to labor availabilities. This adds employment opportunities, provides the impetus for the development of more infrastructure, and yields a higher value product. Finally, palm oil and palm kernels provide an excellent source of foreign exchange in many West African countries in which they are the primary export items, and a major source of Government revenue from export and marketing taxes. In most African countries, palm oil is a major food item too.

Major world production areas

The oil palm, *Elaeis guineensis*, is indigenous to West Africa with natural stands occurring along the coast within a 300-mile-wide belt from Senegal to Angola. All other major production areas are due to extensive planting programs, generally plantations. These occur primarily in Southeast Asia (Malaysia and Indonesia) and Central Africa (Republic of the Zaire, formerly Democratic Republic of the Congo), with smaller plantings in South and Central America. This outlines a land area extending from 15° north latitude to 12° south latitude, which produces over 95 percent of the world production of palm oil.

Africa has remained the largest producer of palm oil, though its percentage of total production has been declining due to increased plantings in the Far East. In 1960, Africa produced 80 percent of the world total versus 19 percent in Southeast Asia and 1 percent in the Americas. By 1970, Africa was producing less than 60 percent of the world total while the Far East portion had increased to 38 percent. The African countries were also retaining a greater percentage of production for domestic consumption, and exports dropped from over 40 percent of total production to 23 percent. This has been reflected in world exports, as the Far East share jumped from 34 percent to 69 percent while the African portion dropped in proportion. The downward trend of African exports should be reversed, however, in the 1970's as palm plantations planted in the mid-1960's start to come in production.

The oil palm produces maximum yields under a very limited range of climatic conditions. These would include (1) a rainfall of 80 inches or more distributed evenly throughout the year—that is, no marked dry seasons, (2) a mean maximum temperature of 85° to 90°F. and a mean minimum temperature of about 72° to 75°F., and (3) constant sunshine amounting to at least 5 hours per day and rising to 7 hours per day in some months. By far, the most important climatic factor affecting production is the density and distribution of rainfall. Dahomey among major palm oil producers has probably the severest climate for oil palm, with a 3-month dry period and an average annual rainfall of just around 50 inches. Average yields there are about 2 tons of oil per hectare compared with yields in Malaysia, which has probably the optimum climate for the cultivation of oil palm, of over 4.5 tons per hectare.

The oil palm is a very diverse plant in that there is a great variation in characteristics. The oil palm, *Elaeis guineensis*, is normally a monecious plant with male or female inflorescences developing at the axils of each leaf. The fruit is a drupe which develops on a rather compact bunch, which is generally by weight 50 percent fruit and 50 percent supportive vegetation. The fruit itself consists of a fleshy oleaginous mesocarp surrounding a nut, the shell of which encases the palm kernel. The fruit exhibits a variation in size and form which greatly affects yield. The internal fruit forms have been divided into three basic classifications, the Dura, Pisifera, and Tenera. The fruit forms are described as follows:

1. Dura: shell 2.8 mm thick, low to medium mesocarp content, 35 to 65 percent.
2. Tenera: shell ½ to 4 mm thick, medium to high mesocarp content, 60 to 96 percent.
3. Pisifera: shell-less.

In wild groves of oil palms, the fruit form most commonly occurring is the Dura. Plantation palms, on the other hand, consist almost exclusively of the Tenera type, which is actually a cross between the Dura and the more rarely occurring Pisifera forms and is more commonly referred to as the DXP varieties. The Tenera fruit generally has an oil content of 20 to 21 percent per ton of fresh fruit bunches (ffb), about twice as high as the dura, while the palm kernel content tends to be about half or about 5 percent kernels per ton of ffb. Thus, with the plantation varieties, there are higher yields of oil and lower yields of palm kernels than occur in the wild groves.

There are great variations in yields among the major palm oil producing regions of the world because of both genetic and environmental factors. But through the 1960's, as tropical countries throughout the world turned to the establishment of estates planted

Table 2.—Analysis of world production and exports of palm oil by major producing regions
[Percent]

Major producing region	Production		Exports		Exports/production	
	1960	1970	1960	1970	1960	1970
Asia	19	38	34	69	86	82
Africa	80	59	66	31	41	23
Americas	1	3	-	-	20	4
World	100	100	100	100	49	45

with higher yielding Dura X Pisifera (DXP) varieties, differences in genetic makeup tended to be lessened while accentuating environmental differences, particularly variations in rainfall. Thus, yields in Malaysia average as much as 22 tons ffb per hectare, those in Dahomey average around 9 tons ffb per hectare, and yields in the Ivory Coast average about 15 tons ffb per hectare. The differences in yields are primarily caused by variations in rainfall distribution throughout the year.

Characteristics and uses of palm oil and palm kernel oil

The composition of palm oil is rather unique when compared to that of the other major fats and oils. Most of the seed oils, such as soybean, rapeseed, and sunflowerseed oils, are composed principally of unsaturated fatty acids and the palm nut oils, coconut and palm kernel, contain predominantly saturated fats. Palm oil, however, is composed of approximately 50 percent saturated fatty acids, primarily palmitic acid, and 50 percent unsaturated fats, principally linoleic and oleic acids. Thus, palm oil having a low acidity will tend to be semi-liquid at room temperatures separating on standing into a deep-red liquid fraction and a yellow solid fraction of about equal volumes. The distinctive color of the oil that varies from an orange yellow to a dark reddish orange, is due to fat-soluble carotenoids, which are also responsible for the high vitamin A content of palm oil. Because of consumer preference for white edible fats, the color generally is bleached out, destroying the vitamin A.

Palm oil finds its major market in the main importing countries in the manufacture of edible products, principally compound cooking fats, margarine, and for both household and bakery use. There is also a limited demand for palm oil for use in the manufacture of soaps and candles, and as a finishing flux in the tinplating industry. Compared to the liquid seed oils, palm oil has a limited utilization, as it cannot compete in the rather large market for liquid table and cooking oils. In many African palm oil producing countries which do not produce seed oils, the palm oil through a fractionating process is separated into a liquid, unsaturated oil portion and a solid, saturated fat portion. The liquid portion is marketed as a table oil and the solid portion used in the manufacture of soaps and hard cooking fats. But this process has not found acceptance in the European and U.S. markets.

Palm kernels, on the other hand, yield an oil having a preponderance of saturated fatty acids, primarily lauric acid. Palm kernel oil is very similar to coconut oil in this respect and the two are virtually interchangeable. The oil is used primarily in the manufacture of margarine and cooking fats with further applications in high-quality soap and cosmetics.

World trade patterns in oil palm products

At the time most African countries achieved independence in 1960, exports of palm oil from the African Continent were at their peak of just over 400,000 tons. Since that time, exports have declined consistently reflecting increases in domestic consumption, declines in operative efficiency as a result of colonial administrative withdrawal, lack of continuing investment in palm plantations because of uncertainty about Government control, and civil unrest causing major disruption in production areas. Exports reached their low point in 1967 as a result of the Nigerian civil war and civil disruptions in the Zaire, settling at 172,000 tons. Up through 1970, exports have remained stagnant at about that level.

Coinciding almost exactly with the decline in exports from the African Continent were increases in exports from Southeast Asia, particularly from Malaysia, which during the 1960's had been planting about 21,000 hectares of oil palms per year. From a level of 200,000 tons in 1960, exports from Asia increased to over 300,000 tons by 1965 and were over 500,000 tons by 1970. This resulted in an overall stagnation of world exports during the decade, varying between 500,000 and 600,000 tons, with a slight expansion in 1969 and 1970 to just over 700,000 tons.

Throughout the 1960's palm oil found its major market in Western Europe. During the 1960-69 period, imports into West European countries averaged 430,000 tons, or about 75 percent of total world exports, with little variance from this level from one year to the next. The largest importing countries during this period were the EC countries which averaged 275,000 tons and the United Kingdom which imported an average of 130,000 tons.

The origin of imports reflects the trends in production described above. In 1960, African nations accounted for 73 percent of the total imports into Western Europe, while Asian countries accounted for 25 percent. By 1970, African countries accounted for only 34 percent of total imports into Western Europe while Asian countries accounted for 61 percent. The shift in the regional source of palm oil imports into Western Europe is summarized in table 3.

Table 3.–Origin of imports of palm oil into Western Europe

Year	Region percent			Total imports metric tons
	Africa	Asia	Other	
1960-62	71	26	3	425,284
1963-65	63	34	3	408,258
1966-68	47	50	3	423,738
1969-70	35	60	5	502,331

Imports from the African Continent to EC countries remained relatively constant throughout the 1960-70 period, averaging 162,000 tons because of the maintenance of trade patterns existing in the colonial period, and the exemption of the 18 Associated African States from the import duty on palm oil. However, Asian nations replaced African countries as the primary suppliers in the rest of Western Europe, particularly in the United Kingdom, as imports from the African Continent into West European countries outside the EC dropped from nearly 160,000 tons in 1960 to under 15,000 tons in 1970. Asian countries also increased their share of the market in the EC, though Africa still remained the primary supplier.

Palm oil also is finding increasing markets in several Asian countries, principally Japan and Iraq, and in North America in the United States and Canada. These markets are being supplied almost totally by Indonesia and Malaysia.

West African Production

Oil palm production areas in West Africa are of two basic types: (1) the wild groves and (2) groves where oil palms have been systematically planted either in plantations or small-holder plots. The wild groves stretch along the western coast of Africa in about a 300-mile-wide belt from the Gambia to Angola. Its range has also moved eastwards through central Africa into the Lake district of East Africa, including Kenya and Tanganyika.

The oil palm does not appear capable of growth in a primary forest and cannot survive and generate in very high secondary rain forests. The spread of the oil palm into these areas has been a function of the pressure of human population on the land and man's interest in the oil palm. Thus, in the process of clearing land for farming, letting it be fallow, and abandoning it, man has created a suitable environment for the growth of the oil palm, free from competition with rain-forest vegetation. Since the oil palm was a natural food source, man became carrier of palm seeds, throwing them away with bunch refuse, where they might germinate in the cleared area. Thus, the density of wild groves was dependent on population density as man cleared the rain forest for his crops.

There are three types of wild palm groves: (1) secondary rain forest with oil palm, (2) palm brush, (3) dense palm groves/farmland with palms. One of the conditions conducive to the establishment of the three types of groves is the shifting of compounds, and the associated drifting cultivation and brush fallow rotation. Variances in population density tend to produce the different types of groves. With increasing population pressure the vegetation type is secondary rain forest with oil palms, while high population pressure results in dense oil palm groves with the oil palm brush as an intermediate type. At a still higher density, the demand for land is so great that palms are felled to make more room for farming. In such districts villages are more or less sited permanently and one of the conditions for development of a grove disappears.

Thus, Eastern Nigeria, which has the highest population density in West Africa, has the highest density of wild palm groves–enough to support exports of well over 100,000 tons since the 1920's until the civil war there in 1967. Throughout the palm belt of West Africa, palm oil produced from wild palms, generally by traditional methods, is enough to support the needs of the indigenous rural population.

During the 1960's there was substantial planting of selected higher yielding palms in plantations and small holder plots. Up to this point in time, the only substantial plantation developments in Africa were in what was formerly the Belgian Congo, now the Republic of the Zaire. Since the granting of independence to a majority of African nations in 1960, there have been major oil palm planting programs in the Ivory Coast, Dahomey, and Cameroon, with smaller projects in Liberia, Sierra Leone, and Togo.

The impetus for this increase in oil palm planting involves one or a combination of the following factors:

1. Agricultural diversification to reduce the dependence on only one or two cash crops, generally coffee, cocoa, peanuts, or rubber.
2. A need for increased foreign exchange earnings.

3. A means of providing a labor intensive source of rural employment and of modernizing subsistence agriculture.
4. Import substitution.

By 1970, there were nearly 300,000 hectares planted to selected palms, either in estates or small-holder plots, in West and Central Africa. The Zaire, which has the largest area in oil palm estates, also has the oldest stands of plantation palms, most of which were planted before independence in 1960. In the other countries, however, the majority of the plantings occurred in the 1960's, and were of even higher yielding varieties. It is these plantings that will dominate trade in palm oil from the African Continent.

These two types of production areas define, though not completely, two types of production marketing systems. First, there is the subsistence sector which is based completely on production from wild palms. In this sector, oil is generally extracted by traditional methods and is consumed locally. Some amounts may be sold on local markets, but all that is produced in this sector is used to satisfy rural consumption requirements.

Second, there is the commercial sector where production is based primarily on oil palm estates, though not entirely. Generally, oil produced in this sector is extracted in large mills, primarily from bunches produced on estates, but also to a lesser extent from bunches harvested from wild palms and bought from farmers. Production in this sector goes primarily into export and into domestic industrial utilization for the production of margarine, table oil, and soaps. Nigeria, however, is unique, in that wild groves are dense enough to support a surplus above rural consumption requirements. Through a system of marketing boards, this surplus, produced mainly by traditional methods, is moved into commercial channels.

Production trends

Palm oil production in Africa averaged just under 1 million tons during the 1960-69 period. There was little variance in production levels during the first half of the decade but dropped dramatically in 1967 due to the Nigerian civil war. It was only in 1970 that production recovered to the prewar level, due primarily to increases outside Nigeria.

The major changes, however, occurred in the distribution between the commercial and subsistence sectors. Commercial production showed a consistent decreasing trend, dropping from nearly 450,000 tons or 43 percent of total production in 1960 to under 270,000 tons, or only 26 percent of total production in 1970. Subsistence production, on the other hand, exhibited an increasing trend, using from 600,000 tons in 1960 to 800,000 tons in 1970, or at an annual rate of 3 percent. This resulted in a relative stagnation in total production.

The causes of these trends were a maintenance of levels of domestic consumption in the face of increasing population, primarily a result of decreasing marketable surpluses in Nigeria. The decrease in commercial supplies resulted in a decreasing trend in exports which was exonerated by an increasing industrial utilization.

Palm kernel production, on the other hand, averaged 750,000 tons during the 1960-69 period. There was a much greater variance, however, in annual production levels than with palm oil. During the 1960-66 period production of palm kernels averaged nearly 800,000 tons, while in the latter part of the decade, production averaged 650,000 tons. This was primarily due to lower production levels in Nigeria, which during the 1960-66 period accounted for over 50 percent of total production.

With the new plantings of oil palms in estates during the 1960's, however, commercial palm oil production levels will show an increasing trend during the 1970's, exceeding the 1960 level by 1975. Assuming that the subsistence sector will maintain its present rate of growth, total production will increase to an estimated 1,400,000 tons by 1975. But, exports will reflect only a moderate increase, rising to nearly 300,000 tons, an increase of 120,000 tons over the 1970 level. Industrial utilization, however, should double to a level of 200,000 tons from the 1970 level of about 100,000 tons. During the civil war, Nigerian production was cut in half, resulting in the large drop in total production in the 1967-69 period.

Palm kernel production should continue to increase through the 1970's though at a smaller rate than for palm oil. This is primarily due to the fact that bunches from the high-yielding oil palms have a much lower kernel content relative to oil content in comparison to the production from wild stands. Production by 1975 then should reach 950,000 tons, a 17 percent increase over the 1960-66 level, prior to the Nigerian civil war.

Nigeria.—Nigeria is rather unique among the major producer-exporter countries in the world in that production of palm oil and palm kernels is based on wild stands of oil palms. These oil palms are low yielding, leaving a dura fruit, and are difficult to harvest. It is estimated that wild palm groves cover an area of about 5.95 million acres (2.471 acres = 1 hectare) extending across the southern part of the country. The groves become denser as one moves eastward across the country. Thus, the area in wild oil

palm groves are estimated at 2.2 million acres in the Western and midwestern States of the Western Region and 3.4 million acres in the three States of the Eastern Region, South Eastern, East Central, and Rivers States.

In addition to the wild groves, there are an estimated 16,000 acres in various types of "improved" oil palm stands, over three quarters of which are located in the Eastern Region. These include estates, farm settlements, and small-holder development schemes. The small-holder development schemes account for about half of the "improved" acreage in oil palms and estates account for another 40 percent.

The real efforts to modernize the palm brush have been directed toward increasing small-holder production. The small-holders are generally individual farmers who have rights to a small tract of land, till the land with family labor, and make their own production decisions. This has been at the expense of any Government policy emphasis on plantation production. The major small-holder oil palm program was undertaken in the Eastern Region during the 1962-68 Development Plan. This program, the Oil Palm Grove Rehabilitation Scheme (OPRS), endeavored to replant 60,000 acres with new hybrid palms during the 6-year plan period. Progress through mid-1967 indicated that the plan would have been met or exceeded if the civil war had not disrupted plantings.

The OPRS program was basically a tree crop subsidy scheme. Generally about 5 years elapse between planting the seedling and the first harvesting of fruit bunches. To provide incentive for planting these palms, participants were paid £ 10 per acre, spread over a 5-year period. High-yielding palm seedlings, grown at the Nigerian Institute for Oil Palm Research (NIFOR), were distributed along with fertilizers. Payments were distributed after inspection of the planted acreage to assure proper planting and maintenance operations. The only stipulation imposed on the small-holder participant was that he plant a minimum of 5 acres at one time in not more than two adjacent lots.

Because of the war which resulted in a lack of maintenance of the hybrid palm groves and a termination of fertilization, the returns to these projects have not been fully realized. Yields under small-holder production are estimated to be about 7,000 pounds of bunches per acre or about 1,500 pounds of oil per acre, 2 to 3 times the yield from wild palms. Because of termination of subsidy payments during the war and loss of confidence by the farmers in the scheme, there is some consternation that another such project will be as rapidly accepted in the postwar rehabilitation of the oil palm belt.

Estates provide the other major type of "improved" oil palm grove. The existing acreage planted to estates is estimated to be 64,000 acres, 57 percent of which is in the Eastern Region. The oil palm estates are almost all owned by the State-controlled Development Corporation. During the war these estates in the Eastern Region were largely abandoned. The groves suffered from a lack of maintenance, including a lack of pruning and growth of the underbrush. Postwar rehabilitation has been slow principally because of a lack of State funds. For instance, the Southeastern State has an area in estates of 27,640 acres, and by the end of 1971 only 15,938 acres were being properly maintained. Yields were still below the prewar normal as the trees take a couple of years to respond to renewed cultural practices. Whereas prewar estate production of palm oil in Southeastern State was 23,400 tons, 1971 production was only at 4,675 tons.

Eighty-five percent of the total production of palm oil, however, is estimated to be derived from wild palm groves. A large part of this production is consumed directly without going into commercial channels. The surplus is generally sold to marketing board agents and thus is commercialized. There are ready statistics on purchases of palm oil and palm kernels by the marketing board. But, statistics on total production are only estimates as there are no firm figures on subsistence consumption. These vary considerably among different sources, primarily because of differences in assumptions used in estimating.

The basic reasoning generally used is to assume that all palm kernels are increasing the surplus of palm oil moving into commercial channels, in addition to supporting domestic consumption levels. Commercial supplies particularly increased in the postwar period up to 1960 as a result of high prices and small-holder extraction program. Commercial supplies peaked about 1960, however, and fell through the decade, hastened by the civil strife in 1967-68. This was primarily due to a relative stagnation in production with a continuing increase in domestic consumption. This would seem to imply that Nigerian palm brush is reaching maximum utilization, and that further increases must necessarily result from productivity increases. These estimates seem to imply that commercial supplies from wild groves will be nearing only about 50,000 tons by 1975. And this estimate is based on full recovery of the palm area from the effects of the civil war by that time.

The low estimate of the range is derived primarily on the basis of palm kernel production, all of which is assumed to be commercialized. This method takes into account a slight discrepancy in production between the Western Region which includes the

Western and Midwestern States, and the Eastern Region, which includes the Southeastern, East Central, and Rivers States. The discrepancy derives from the fact that both regions have nearly equal populations and produce a nearly equal amount of palm kernels, yet the Eastern Region has consistently commercialized well over 100,000 tons of palm oil per year (that is, until the civil war in 1967) while the Western Region commercialized a relatively insignificant amount. This is probably due to the harvesting of a certain amount of palm kernels in the Western Region from decomposed fruit that has fallen to the ground, thus resulting in a lower output of palm oil relative to palm kernel production.

Total production is therefore derived from the following assumptions. In the Eastern Region, palm oil production is derived from palm kernel production by multiplying by a factor of 1.3. This results in a per capita consumption level of 10 kilograms. This consumption level is applied to the population of the Western Region to ascertain production of palm oil in that area. There is also a relatively small production of palm kernels in the fringe areas in the Northern States. These are converted to palm oil by a factor of 1.0 and added to the total.

The results using this method, though yielding a lower estimate of total production nevertheless show somewhat similar trends. Discounting the effects of the civil war, production of palm oil seemed to stagnate over the period under review. Subsistence consumption increased, principally as a result of increasing population, resulting in a decline in commercial supplies of palm oil.

Palm kernel production increased consistently from the early 1930's to the late 1950's. At that time, production stagnated, peaking at about 460,000 tons. Through the 1960's up to the civil war in 1967, palm kernel production declined moderately. This was primarily due to a decline in producer purchase prices, and in the Western Region, to an increase in cocoa prices, resulting in a shift of labor to the more easily harvested crop.

Stagnating production of palm oil and palm kernels, with a particular drop in commercial supplies of palm oil, indicates that the wild palm groves particularly in the Eastern Region probably are being maximally utilized. Population density in the Eastern Region is the highest on the African Continent (except for the Nile River Basin), averaging over 500 people per square mile, and in some areas reaching over 1,000 people per square mile. The normal production growth of 3 percent per year results in increasing pressure on the land, particularly for food crops, and could eventually result in the felling of some palms.

Realizing this the Ministry of Agriculture undertook to increase the productivity of the oil palm areas in the 1962-68 Development Plan, principally through its small-holder oil palm rehabilitation scheme. Though initially successful, the scheme was terminated by the disruption of the war. Though the area planted under the scheme should now be in production, there has been no means of estimating its impact on production due to the slow pace of postwar recovery. Furthermore, the 1970-75 development plan only establishes guidelines for the postwar recovery of the palm oil industry, as opposed to further expansion, particularly as relates to the restoration of small-holder processing facilities.

Republic of the Zaire.—The oil palm industry was established in the Congo in 1912 when Sir William Lever was granted large land concessions for his company, *Huileries du Congo Belge*. Initially, the factories were supplied by exploitation of wild palm groves. In the 1930's, however, with the first experimental work with the *Tenera* palm, the palm industry turned toward the planting of plantation palms to supply the extraction plants. This decision set the pattern of development for the palm industry up to independence in 1960. The real increase in plantings of plantations to oil palms began in the late 1930's and early 1940's with a slack period ensuing during World War II. By 1959 the plantation area planted to oil palms reached 247,233 hectares. Also, at this time, 23,144 hectares of wild palms were included in the plantation operations. This is in addition to the fruit bought from small holders. Of the total palm area in plantations in 1959, 60 percent was owned and operated by European interests, the other 40 percent being managed by Congolese.

Following independence in 1960, the plantings of high-yielding palms in plantations dropped dramatically declining an estimated 60 percent from the level prior to independence. With the ensuing political instability and civil unrest in the 1964-67 period, new plantings of palms ceased altogether. Since the restoration of civil order in 1967, there has been little reported plantings of oil palms. The largest palm oil producer in the country began in 1969 to replant some older groves—about 600 hectares per year—but it abandoned 14,700 hectares between 1964 and 1970 due to the effect of the civil disturbances.

There are no reliable estimates of the present hectarage of oil palms in production, though it appears to be well below the 1959 level due to abandonment of prior acreage. Moreover, the civil disturbances appear to have most affected the Congolese producers to whom most of the drop in production is primarily attributed.

There are basically three palm oil producing areas in the Zaire. The palm industry got its start in the vast natural groves along the Kasai River. It is estimated that natural groves cover an area of 400,000 hectares in this region, primarily in Bandundu Province, stretching down into Kasai Province just beyond Fort Franqui. The industry in this region is centered around Kikwit.

There is a smaller palm growing area in Bas-Zaire near the mouth of the Zaire River. The industry here is centered around Tehela. As in the Kasai Region, production in this region depends on natural groves in addition to plantation production. The area planted to plantations in these two regions in 1959 was 78,340 hectares, or about 40 percent of the total.

The major producing region occurs much farther inland along the upper reaches of the Zaire River in Equateur and Haut-Zaire (Orientale) Provinces. The principal area is located along the river between Lisala and Kisangani. This area is more dependent on plantation production than the other two regions, with area planted to plantations in 1959 being 109,586 hectares or 56 percent of the total. This area produces much better yields than the other two regions primarily because of the much shorter dry season.

Table 4.–Yield approximation for oil palms according to method of cultivation

Method of Cultivation:	Yield (oil hectare in KG)
Extensive methods:	
Traditional	150-500
Improved	300-1,000
Intensive methods	1,000-3,000

Yields in the Zaire have increased substantially as the palm industry turned to plantations. This was principally a result of the oil palm research conducted by the Institut National pour L'Etude Agronomique du Congo (INEAC) at its research station at Yaligimba, and the distribution of these higher yielding seedlings.

Before the widespread introduction of the plantation system during the 1920's, the average palm oil yield from the better natural palm groves was around 0.2 metric ton (2.471 acres = 1 hectare). When palm plantations were planted to common seeds, the yield went to about 0.4 metric ton per acre. The next important increase in yields resulted from planting pure strains of Tenera palm seeds distributed by INEAC during the 1930's. Plantations planted to these seeds yielded about 0.7 metric ton of palm oil per acre under favorable conditions. When Dura and Tenera palms were crossed, the resulting hybrid trees yielded about 0.8 metric ton of palm oil per acre. Seeds from this cross were distributed by INEAC beginning in 1941. Several years later seeds obtained by crossing Tenera with Pisifera were distributed. Under favorable conditions this yielded about 1.2 metric tons of oil per acre.

Finally, INEAC begun in 1952 distributing the Dura-Pisifera cross (DXP variety), which consistently yields 1 ton of palm oil per acre. In 1959, INEAC distributed 2.4 million DXP variety seeds. However, since the disturbances in 1964, the INEAC station has not returned to operation. All plantings now are from seedling stock produced on the plantation itself and a small amount of imported stock. This has further contributed to the dominance of the large plantations on palm oil production because the smaller ones, particularly the small Zairian controlled plantations, do not have the capacity to produce seedling stocks.

The palm industry in the Zaire now appears to be at a stasis. The palms planted in the 1930's and 1940's during the large planting expansion should have been replanted during the 1960's. But because of the civil unrest during this period, there was little attempt to continue replanting projects. In many cases these plantations were abandoned, particularly the smaller Zairian controlled plantings. The larger plantations also chose to abandon large areas. P.L.Z., the largest producer in the Zaire, abandoned 14,700 hectares between 1964 and 1970, or over 30 percent of their total area under cultivation, and are concentrating their harvesting efforts on high-yielding groves planted during the 1950's and early 1960's. This company began in 1969 a small replanting program of about 600 hectares per year to maintain the capacity of their extraction units. DXP variety palms were planted at the plantation in Leversville, but because of the relatively long dry season, there was a very high mortality rate and the experiment was abandoned. The company thereby concentrated on new plantings on their plantations in the north along the Zaire River.

One additional factor has contributed to abandonment of oil palm acreage. This has been the apparent labor difficulties being encountered by the plantations. This problem is primarily due to relatively low wages and the movement of the younger males out of the rural areas into the urban areas. Plantation managers report that this has resulted in a reluctance on the part of the native laborers to climb and harvest the older, taller trees. They prefer to harvest only the younger shorter trees from the ground with Malayan knives. This too has caused the plantations to concentrate on their younger, higher yielding groves.

Total production is difficult to estimate because of the lack of information available on subsistence production. Also, in the years following independence, there is also variation in statistics on

commercial production. However, the year 1959 can be used as a standard base for comparison. Commercial production of palm oil peaked in 1959 at 245,000 tons; production of palm kernels at that time was 161,000 tons. The breakdown is in table 5.

With independence in 1960, commercial production declined as a result of lack of continuing investment in palm plantations because of political uncertainties, declines in overall operative efficiency as a result of colonial administrative withdrawal, and civil unrest causing major disruptions in the producing area. Production declined consistently in the 1960-66 period, reaching a low point in 1966 of 123,000 tons. This was principally a result of the civil unrest spreading into the northern production area around Kisangani. With political stability ensuing in 1967, production increased to a level of around 170,000 tons in 1968. Production of palm oil has remained at this level through 1971, which would seem to indicate that acreage under cultivation has dropped to a point of stabilization. With little new plantings, there seems little possibility for expansion in production.

Through the 1960's with the decline in transport systems and marketing services, the drop in production appeared to be mostly associated with the decline in production of palm fruit from indigenously controlled plantations. This resulted in an increased concentration of palm oil production in the large European-controlled plantations. Thus, the two largest plantation systems accounted for over 50 percent of total production in 1970, compared to approximately 30 percent in 1959. Also, these plantations, particularly those in the northern provinces, began to depend more on their own fruit production than that indigenously produced and then sold to the plantation. Thus, P.L.Z., the largest plantation system in the Zaire, processed only 30 percent of its fruit from Zairian origins in 1970, compared with 60 percent in 1959.

Thus, with the heavy dependence in small-holder produced fruit in Kasai Province and the unfavorable conditions for growing high-yielding plantation palms there, production in this province in recent years has stagnated, though apparently at the preindependence level. This province, however, is beset by labor difficulties and high production costs due to the following factors: (1) increasing minimum wage rates, (2) maintenance of a very extensive road system in order to harvest wild groves, (3) lower oil extraction rates from wild palm fruit, resulting in higher processing costs, (4) lower quality oil than plantation oil due to increased elapsed time between harvest of wild groves by small holders and processing, and (5) very outdated processing plants. Production in this province thus depends on a relatively high export price for palm oil.

Production in the northern provinces seems also to have stagnated due primarily to the mature age structure of the plantation palms. Any expansion in production, however, will necessarily have to come from this region.

The real decline has come in small-holder production of palm oil, primarily Zairian. This is best reflected in shipment of oil in barrels rather than in bulk. Transport of palm oil in barrels in 1959 was 34,638 tons compared with only 5,783 tons in 1970. This was primarily due to the civil strife dislocating the population and the postindependence decline in marketing and transport services.

Dahomey.—Though a relatively minor exporter of palm products, Dahomey nevertheless derives between 50 and 70 percent of its export earnings from trade in palm oil, palm kernels, and palm kernel oil. Due partly to this fact and partly to a lack of other viable cash crop alternatives, the Dahomey Government initiated a program during the 1960's to plant substantial acreages of plantations to oil palms.

Table 5.—Republic of the Zaire: Production of palm products

Province	Palm oil			Palm kernels		
	Zairian	European	Total	Zairian	European	Total
Kinshasa, Bas-Zaire, and Bandundu	3,154	92,262	95,416	29,418	52,070	81,488
Equateur	2,241	68,160	70,401	11,240	24,560	35,800
Haut-Zaire (Orientale)	3,100	64,423	67,523	6,234	23,692	29,926
Kivu	500	794	1,294	50	181	231
Shaba (Katanga)	159	44	203	1,375	-	1,375
Kasai	2,790	7,589	10,379	9,233	3,691	12,924
Total Zaire	11,944	233,272	245,216	57,550	104,194	161,744

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Figure 1—An all-weather road through an old palm plantation in West Africa. Extensive ferns on the palm trunks indicate a need for better cultivation processes.

Figure 2—Palm seedlings being cared for at a typical nursery.

Figure 3—Palm bunches are loaded at a collection point onto a narrow gage railroad for delivery to processing plant.

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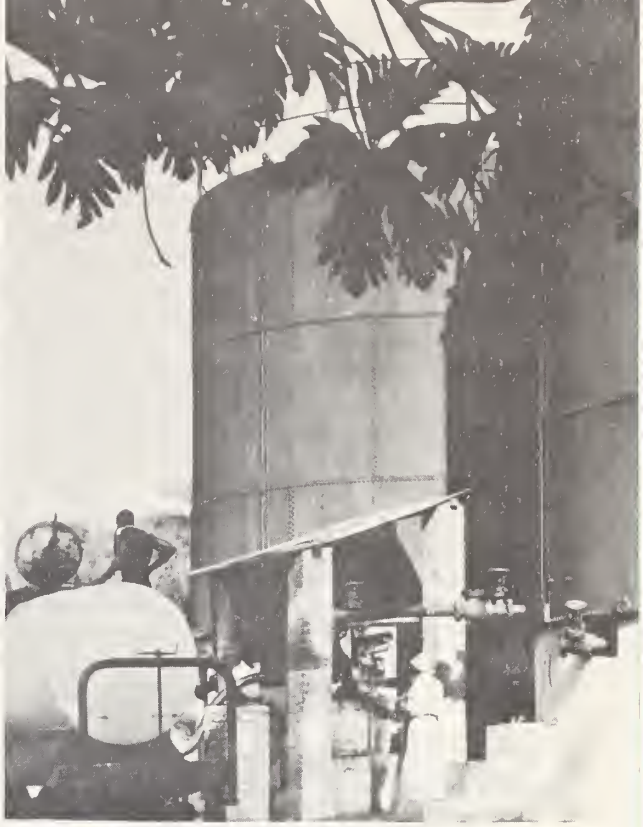

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Figure 4—A worker delivers cut palm bunches to a collection point. The hoop facilitates climbing up trees to cut palm bunches.

Figure 5—Palm oil is loaded from storage tanks to rail tank cars.

Figure 6—Harvesting of palm fruit.

Figure 7—A collecting depot for the oil palm bunches prior to processing and removal of palm kernels. The bunch refuse is a source of potassium after the kernels have been removed.

At independence in 1960, production of palm oil in Dahomey was dependent on the exploitation of wild groves. It is estimated that there are 400,000 hectares in wild palms located in the southern third of the country of which only about 225,000 hectares are exploited. Yields from wild palms average between 250 and 300 kg of oil per hectare. At this time, there were only about 2,100 hectares of oil palms in plantations, the planting of which was begun in 1955.

In 1962, SONADER (Societe Nationale de Development Rural) an autonomous government-owned company, implemented a very successful palm plantation program, designed to increase exports substantially. The program was concentrated in three primary projects (all about 65 kilometers north of the coast—the Mono (in Mono Province), the Grand Honor (northwest of Porto-Novo), and the Agonoy (north of Porto-Novo) projects. The projects were undertaken with the financial assistance from FAC, EDF, and IBRD. By the end of 1971, 27,000 hectares of oil palms had been planted in plantations.

The plantations, while Government owned, are set up as cooperatives. An area is planted to oil palms and an equal area is set aside for the cultivation of food crops. Central housing is provided between the two plots. The labor is designated certain tasks and organized under managers, and the laborers receive 125 CFAF per day. Theoretically, some profits based on the particular projects production are to be redistributed back to the laborers, though none has been up to this point.

Yields of the plantation palms, however, are among the lowest in West Africa, due principally to the low and poorly distributed rainfall. In the oil palm region, there is a severe dry season lasting 4 months from November to February. The total annual rainfall averages only about 54 inches at the Poke palm research station with a variation as much as 30 percent. There are certain soil areas, however, that have a high water-carrying capacity which compensates somewhat for this water deficit. Plantation palms at full maturity (9 years of age) average about 9 tons of bunches per hectare. This compares to an average of about 15 tons in the Ivory Coast. Fruit bunches yield about 21 percent oil and 3.8 percent kernels.

Over 55 percent of the acreage in plantation palms was planted after 1967. Thus, palm oil production is only now starting to show significant response to the increases in plantings. Through the 1960's commercial production of palm oil depended primarily on exploitation of wild groves by small holders, the bunches being sold to SNAHDA, the Government-owned company responsible for palm oil processing in Dahomey. By 1971, about 60 percent of commercial palm oil production was derived from plantation produced bunches.

Commercial production of palm products has trended upwards over the past 5 years.

Subsistence production is estimated at nearly 30,000 tons. This is produced by traditional methods and is consumed locally, with the palm kernels being sold to SNAHDA.

Ivory Coast.—The palm industry in the Ivory Coast follows much the same history as that in Dahomey. Up through the 1960's, production of palm oil depended primarily on the exploitation of wild groves. These are estimated to cover an area of 700,000 hectares, but are generally of a relatively low density making commercial exploitation infeasible. Additionally, in 1960 there were 6,700 hectares in plantation palms. These were distributed among three private plantations, each with its own mill and the three IRHO (a French-based palm research organization) research stations.

Table 6.—Dahomey: Commercial production of palm products[1]
(metric tons)

Period[2]	Palm oil		Palm kernel		
	Bunches collected	Production of oil	Production of palm kernel	Palm kernels crushed	Production of palm kernel oil
1965-66	107,240	9,689	8,153	46,040	19,161
1966-67	73,882	6,891	5,510	34,405	18,253
1967-68	98,371	8,850	7,185	49,989	23,090
1968-69	122,882	12,408	9,909	55,628	25,545
1969-70	134,050	14,265	10,287	51,177	23,255

[1]Operations of SNAHDA.
[2]Period Nov. 1-Oct. 30.

In the 1960-70 Development Plan a major allotment of funds was devoted to agricultural diversification projects to relieve the dependence on traditional exports, primarily coffee and cocoa, and to stem the migration of labor into the urban areas. The oil palm project begun in 1962 was by far the largest of the projects, having received, by the end of 1967, 40 percent of the funds invested in agricultural development projects. In 1963, the Government oil palm plantation program was put under the authority of SODEPALM (the Society for the Development and Exploitation of the Oil Palm), a State agency responsible for the planning and execution of the program.

The oil palm was divided between two different types of plantations. A central industrial plantation was planted adjacent to an oil extraction mill. Also, in a 12.5-mile radius from the mill, village plantations were developed, with SODEPALM supplying the seedlings, fertilizers, and technical assistance. The central mill provides training and guidance to the small-holder cooperatives in harvesting and cultural techniques and provides the transport for pickup of the fruit bunches. As of 1970, there were 40,500 small holders in the program.

By the end of 1970, 67,563 hectares of oil palms had been planted in plantations. This included 36,982 hectares in SODEPALM-owned industrial estates; 18,672 hectares in small-holder plantations; and 11,909 hectares in private, including IRHO, estates.

The palm project was financed by EDF (European Community Development Fund) grants amounting to $36.5 million, IBRD loans of $16.7 million, and Government and private foreign investment funds. To date, just over $100 million has been invested in the oil palm program.

These principal entities are now involved in the management of the oil palm program. In 1969, as the program came into its productive phase, two additional organizations, PALMINDUSTRIE and PALMIVOIRE, were formed to complement the activities of SODEPALM. SODEPALM's original responsibility was to develop and manage all aspects of the Government's oil palm project. However, with the formation of the other two companies, SODEPALM's tasks were confined to the development and management of the village plantations which included the supplying of services to the small holders. PALMINDUSTRIE, of which 73 percent is Government owned and 27 percent is owned by private interests, merely has title to the palm oil mills, ancillary equipment, and the bulk oil stations. PALMIVOIRE, where ownership is 40 percent Government and 60 percent private interests, now directs investment in and manages the industrial estates, including management of the oil mills. It also has control over the collection processing and sale of all palm oil production.

Yields obtained from the oil palm plantings in the Ivory Coast are relatively high, compared to yields from other palm plantings in West Africa. The annual rainfall is adequate and the dry season is relatively short. Average yields of palm oil are estimated by IBRD to be as follows, in tons per hectare:

Item	Years after planting				
	4	5	6	7	8
Village plantations	0.35	0.85	1.40	2.00	2.20
Industrial plantations ..	0.80	1.53	2.30	2.94	3.15

Through 1968, the Ivory Coast remained a net importer of palm oil. Commercial supplies were dependent on the output from six small private plantations which produced an average of under 10,000 tons per year. To meet industrial requirements, these supplies had to be supplemented by imports of oil. Beginning in 1969, however, the new plantings started to come into bearing and production of oil rose to 21,441 tons. Production doubled in 1970 to 42,463 tons, and the Ivory Coast exported 12,542 tons above its domestic requirements.

By 1970 PALMIVOIRE was the largest producer of oil in the Ivory Coast, processing 24,460 tons of oil in its five mills, while the six private firms produced 18,000 tons. In total, 235,500 tons of bunches were factory processed. Almost all the bunches crushed were produced on oil palm plantations, with only about 10,000 tons bought from small holders who harvested wild groves. These are almost all crushed in the mill at Dabon to supplement the plantation production. Harvesting of wild groves for sale to mills, however, has declined over the decade as mills have turned more and more to plantation production, and in time will be phased out entirely.

Finally, about 250,000 tons of fruit bunches are harvested from wild palms and processed by traditional methods. Because of the low oil content of the fruit and the inefficient processing method, subsistence production of palm oil only amounts to about 17,000 tons, or about a 7-percent extraction rate. This supplies the major portion of local food requirements for oil. This is supplemented somewhat by sales of oil on the local markets by the oil mills, amounting to approximately 6,000 tons.

Table 7.–Ivory Coast: Palm bunch production
(1,000 metric tons)

Item	1965	1967	1968	1969	1970
Factory processed	74.3	87.2	96.1	128.5	235.5
Traditionally processed	255.0	260.0	245.0	245.0	265.0
Total production ..	329.3	345.3	341.1	373.5	500.5

Production practices

There is a great variation in cultural practices applied to oil palm grown in West Africa, ranging from the subsistence harvesting of wild palms to the large, efficiently operated plantation systems. Four types of palm groves can be delineated based on the sophistication of cultured practices applied to the trees and the organization of the exploitation of the groves. The four types of groves are (1) wild groves, (2) improved groves, (3) small-holder plantings, and (4) plantations.

Wild Groves.–Domestic requirements for vegetable oil as food in the tropical areas of West and Central Africa are supplied almost completely by the exploitation of wild groves. The subsistence form of agriculture generally results in the exploitation of the groves to meet individual consumption requirements, the oil being extracted by traditional methods. Where marketing and transport services are provided, which are generally supplied by a nearby processing mill, the groves may be exploited for monetary return. In some instances, for example, Eastern Nigeria, palm oil produced in the villages will be sold to commercial buying agents.

This form of exploitation requires few, if any, forms of cultural practices applied to the groves; ripe fruit bunches are merely harvested from the tree. There is some maintenance of the trees by mere harvesting, as this results in pruning of the necrotic leaves and cutting of the epiphytes.

There is a large variation in the percentage of the wild groves harvested, depending on (1) density of the groves, as the denser the groves, the more economic their exploitation; (2) population density; and (3) availability of transport and processing facilities. Eastern Nigeria provides the best example of the exploitation of wild groves. The population density is one of the highest in Africa, the tree density varies between 10 and 100 per acre (the largest wild palm area in Africa), and Nigeria has a well-organized produce marketing board system. This has resulted in almost complete harvesting of the palm groves. In many cases, palm trees are harvested collectively by the village as a whole. This is a result of the fact that rights to land often do not extend to rights in wild palm trees growing on that land. The palm bunches are then generally processed in the village compound using either traditional methods or hard screw presses.

Improved Groves.–In many cases where oil mills have depended on wild palms to supply fruit bunches for processing, efforts were made to increase efficiency. To guarantee less variation in supplies, mills looked to means to increase yields. In some instances, planting plantation palms did not seem to be a practical alternative and the mills turned to increasing the yields of the wild palm groves–the improved groves.

Cultural practices applied to wild groves to increase yields generally included (1) clearing of the undergrowth to reduce competition for water and nutrients, (2) pruning of necrotic leaves and epiphytes, and (3) thinning of the groves to a specified density, generally between 55 and 80 per acre. Yield increases have been generally associated with spacing effects: thinning and clearing away brush from around groves resulted in a reduced competition for light and nutrients and thus an increase in yields of palms.

Because of the generally limited returns to the additional costs and the complexity of organizing road and harvesting systems among the groves, there has been limited adoption of cultural practices applied to wild groves. The major area, still relying on improved groves for production of oil in the palm industry, is in Kwily District in the Zaire. The long dry season causes a high mortality rate among plantings of high-yielding palms and thus mills must rely on the wild groves. These mills have to maintain extensive road systems and because of the relatively wide distribution of the groves there is an increased time lapse between harvesting and processing over plantation operations. These factors, plus the lower yields of bunches and the lower oil content of the fruit, result in increased operation costs relative to plantation operation.

Small-Holder Plantings.–With the improvement of planting material both in terms of yield and disease resistance, the development of superior planting techniques, and the increased availability of fertilizers, the palm industry and also the governments in West African countries began to look to planting as a solution to increasing efficiency of palm oil production. While the mills started planting oil palms in plantation systems, the indigenous governments, particularly in the 1960's, concentrated on increasing production among small holders.

This was particularly true in Nigeria with its Oil Palm Rehabilitation Scheme, and in the Ivory Coast, with its SODEPALM village plantation program. There had

been a particular emphasis on small-holder schemes in the Zaire (formerly Democratic Republic of the Congo) in the 1950's, but this declined considerably after independence in 1960. Major small-holder plantings have generally been associated with Government programs. This is due primarily to the lag of 4 to 5 years between investment returns; that is, between clearing of wild palms and planting and initial harvest. Because of limited cash flows among small farmers, there is little incentive to invest in seedlings and fertilizers.

Production practices on these types of groves vary according to the comprehensiveness of the Government program. Generally, seedlings, fertilizers, and technical assistance are provided in addition to a cash incentive payment which is spread over 4 years. In the Ivory Coast, cultural practices on village plots are tightly controlled. Technical assistance is provided during planting, and pesticides and fertilizers are distributed and credited to the small-holder accounts. Roads are built in the area and pickup schedules for harvested bunches are provided. Furthermore, production from each plot is monitored to ascertain whether the small-holder is following through with the services provided.

In Nigeria, maintenance of the groves is monitored less than in the Ivory Coast. After planting and initial application of fertilizer, the small-holder generally relies on his own resources in maintenance of the grove. This undoubtedly results in a decline in use of pesticides and fertilizers that must be purchased, though underbrush is generally kept cleared and palms are pruned. Also, processing facilities in Nigeria are limited, depending primarily on Pioneer oil mills cooperatives, and often the producer must provide for transport of the bunches to the mill. This results in delays between harvesting and processing.

Plantations.—Plantations offered the solution to the most efficient means of producing palm oil. The time lag between harvesting and processing was minimized; palm groves were systematically planted, maximizing yields and minimizing outlays on roads and labor; and production was easily geared to the capacity of the mill. The plantation increased its per acre rate of investment and intensity of cultivation in order to maximize yields, and thus most efficiently supplied its mill with raw material.

Plantation development increased sharply in West Africa during the 1960's, particularly in the Ivory Coast, Dahomey, and Cameroon, with smaller plantations being started in Liberia and Sierra Leone. In the Zaire, plantations became the most viable source of production. It is this sector that shows the most potential for growth during the 1970's and will eventually supply almost all the exports from West Africa.

Vast consideration is given to the most economical location and layout of the plantation. Location is generally determined by nearness to the mill, soil characteristics, and terrain. Layout of the plantation grove is based primarily on minimizing labor costs by supplying an adequate road network, but on the other hand maximizing the total productive area.

There is some variation in preparation of land for planting, but generally the methods follow the following procedure. First, the underbrush is cut to make access easier. The forest trees are then felled, heaped, and burnt. Then rows are laid out for the palms and paths are cleared. Finally, a leguminous cover crop is sown to check growth of vegetation and prevent runoff.

Planting of the palm seedlings is influenced by those factors which minimize the time between plantings and the first harvest. Firstly, the older the seedling is at transplanting the earlier the tree starts yielding; however, the more vegetation the plant has, the more severely it suffers during transplant and the more difficult it is to handle. Generally, 12- to 18-month-old seedlings give the best response.

Secondly, the method of transplanting greatly influences this time interval. This relates primarily to the condition of the root system during replanting. To sustain the plant, the seedling is transported between nursery and field with the roots encased in a big ball of earth. This is accomplished in two ways. In one instance, the plant is dug from the nursery bed. Six weeks before unearthing, a spade is used to cut the primary roots around the plant so that smaller secondary roots will develop, giving the plant a more extensive root system. Recently, plantations have been turning to growing the seedlings in plastic bags of earth, and transporting them directly to the field, thus without disturbing the root system.

Thirdly, the seasonal timing of the planting is important to the quick growth of the seedling. Most palm areas in Africa have two dry seasons of varying length, and two wet seasons. Generally, the plantings take place at the beginning of a wet season, so the plant is well established before the dry season sets in.

After planting, an area around the plant in a 3-foot radius is cleared of vegetation and mulched. To prevent rodent damage, which can be widespread in palm areas, wire collars are placed around the seedling. Pesticides are applied for any attacks on the plant by insects, particularly the African spear borer, which bores through the radii of the leaves. Fertilizer is often applied, the type and quantity depending on soil conditions.

Maintenance operations of the palm groves are designed to keep the palms at peak yields throughout

their economic life, generally 25 to 30 years. These include maintaining a leguminous cover crop to prevent growth of competing plants and to preserve soil moisture, pruning of necrotic leaves and epiphytes, fertilizing depending on the soil fertility, and weeding around the palm base.

Harvesting methods on African plantations have evolved from climbing the trees and cutting the fruit with a cutlass to the widespread use of the Malayan knife, a hooked blade at the end of a long lightweight pole that is manipulated from the ground. A grove is generally harvested on about a weekly cycle, with laborers working in a two-man team. One cuts the bunch and the necessary leaves, while the other acts as carrier, transporting the bunch to the nearest road.

"Harvesting is carried out with the object of obtaining the maximum quantity of palm oil of a quality, as judged by the free fatty acid content, acceptable to the purchaser. Underripe fruit contains less oil than ripe fruit, overripe fruit provides oil of a higher FFA content. Ripening takes place unevenly over the bunch, and although the period from anthesis to harvest is shortest in dry season, the final ripening of full developed bunches is hastened by wet weather.

Generally, a criterion for harvesting is developed for the grove based on the number of loose fruit lying on the ground, attempting to maximize returns by getting the bunch at a ripe enough stage to maximize oil content of the fruit without decreasing the quality of the oil; that is, increasing the FFA content.

Palm Fruit Processing Industry

More than for any other oilseed crushing industry, the type and efficiency of palm fruit processing operation is a primary determinant of the quantity and quality of palm oil produced. This is due primarily to the particular characteristics of the palm fruit and secondarily to the degree of organization involved in harvesting and processing the palm bunches.

The quality of the oil is inversely related to its free fatty acid (FFA) content. When palm fruit becomes overripe or bruised, enzymes present in cell tissues are activated causing lipolyis, the plotting of fat molecules by hydrolysis into its components fatty acids and glycerol. This increases the free fatty acid of the oil, thereby decreasing the quality. The major part of free fatty acid formation comes before processing. Thus, provisions in the palm fruit processing operation must be made for the rapid processing of the palm bunch and the arresting of enzyme action in the cellular tissue.

Palm fruit contains a very active lipolytic enzyme, lipase, which is only effective in the breakdown of fats into fatty acids and glycerol when the cellular structure of the fruit has been disturbed. This is due to the separation of the lipase and fats in the cellular tissue by a thin membrane. Oil from fresh ripe fruit contains as little as 0.1 percent FFA but in bruised, crushed fruit the FFA content may increase to 50 percent in a few hours. The enzyme, however, is completely inactivated by high temperatures, 55° C. being sufficient to prevent further enzyme action.

Because of the need for rapid processing of the palm fruit after harvesting, extraction of palm oil takes place in the production area. Various methods of palm oil extraction, differing in technique and scale of operation, are used depending on the various characteristics of the means of production; for example, the expertise of the producer, the source and quantity of supply of palm bunches, the organization of the fruit harvesting and delivery operation, and the supply of capital available to producers. The oil extraction efficiency (oil recovered as a percentage of total oil available in mesocarp) can vary from as low as 40 percent for the traditional methods to 95 percent for the fully integrated palm oil mill. Generally, the extraction efficiency varies directly with the cost of processing, though the increased oil output more than covers the increase in processing costs. Thus, the quantity of oil production depends quite heavily on the means of extraction. Generally, the more organized the harvesting operation is with processing operations and the less variation there is in supplies, the more efficient the extraction method to be used. Thus, plantations generally depend on fully integrated refining mills while small producers harvesting wild palms will depend on screw presses or traditional methods.

Processing techniques

Extraction of palm oil from the bunch requires five basic operations common to all types of processing methods. These include (1) sterilization of the bunches, (2) stripping of the palm fruit from the bunch, (3) maseration of the palm fruit, (4) oil extraction, and (5) oil clarification. The various methods differ in scale of operation, extraction efficiency, and the ratio of capital to labor usage.

The traditional methods employed before the advent of machinery yielded an oil of generally poor quality and resulted in a low extraction efficiency. Generally, processing was organized around rural communities,

with production dependent on the amount of labor available. Two basic methods existed, the so-called "hard oil" and the "soft oil" processes.

The "hard oil" method generally produced an oil with a high FFA content varying between 30 and 50 percent that was semisolid at air temperatures. In the "hard oil" process, the fruit bunches are brought to the native's compound, stacked in piles and covered with palm fronds or plantain leaves and left for about 4 days to loosen. After the fruit is shaken from the bunches, it is left to ferment for another 6 days or so for further softening of the mesocarp. Then, approximately 10 days after harvesting, the fruit is placed in a mortar—initially a rock-bottomed wood lined pit, later half of a 44-gallon drum—where it is pounded with long wooden pestles. The macerated pulp is again left to undergo fermentation for 12 hours and then after adding boiling water, a second pounding is administered. The pulverized fruit is now ready for the third step, oil extraction. This is carried out by applying pressure to the pulp—either by wringing in a net or trodding upon in an inclined open-end "canoe.' The wrung pulp still contains the nuts which are now separated from the fiber; later, the nuts are individually cracked between rocks to yield the palm kernel. The process of softening, pounding, and squeezing is then repeated a second time. The mixture of palm oil and water so obtained is boiled in a large pot and the oil skimmed off.

An alternative method (the "soft oil" process) that yielded an oil with a lower FFA content developed in great palm areas of Eastern Nigeria, which yielded the bulk of early export supplies of palm oil, and is the primary traditional method employed today. This method differs from the "hard oil" method primarily in that the bunches are boiled (sterilized) at an early stage. The harvested bunches are cut up and left to soften for 1 to 3 days. Then the fruit is picked off by hand and boiled, generally in a 44-gallon gasoline drum, thus reducing FFA formation. The pounding and squeezing of the pulp proceeds the same as in the "hard oil" method. The palm and water is boiled and the oil skimmed twice, finally being "fired" in a small pot to remove the last vestiges of water.

Extraction efficiency varies. The amount of oil extracted depends largely on how far heat has been maintained, throughout the process and how assiduous the women are in skimming and in teasing out the fibre. Usually the mass of pounded pulp is allowed to cool off and extraction rates are low. Such figures as exist for extraction rates in the soft oil process, that is, 6 to 10 percent oil to fruit of low mesocarp content, suggest that a normal efficiency (extracted oil to total oil in the fruit) would be 40.45 percent, occasionally rising to 50 percent, but sometimes falling to as low as 30 percent. Average FFA content used to be about 7.12 percent, but lower FFA oils can be produced by this method (sometimes as low as that achieved by most mechanized techniques).

The hard oil method yields a slightly higher percentage of extractable oil than the soft oil method. The hard oil method still remains in use in certain areas, though the oil is generally for home consumption. This is because this method requires less labor and entails less fuel costs, and in some areas there seems to be a taste preference for the hard oil.

At the end of World War I it was realized that traditional methods would not produce enough quality palm oil to meet the growing world demand. An effort was therefore launched to increase the efficiency of palm oil extraction by small-scale producers through some type of mechanization, though not to the extent of large-scale plantation oil mills. Though certain improvements were made in the ancillary equipment—drying tables, separation boards, barrel halves, and sequence timing—the real mechanization came in the oil extraction phase of the process.

Around 1930, the Duchser screw press was introduced in Eastern Nigeria where it began to capture the market for relatively low-priced oil extractors. Also known as crub presses, the screw press was hand operated, handling about 150 pounds of fruit in each change, and gave extraction efficiencies of 55 to 65 percent with a maximum efficiency of around 70 percent, achieved only under optimum conditions in which the fruit pulp is kept hot during pressing. Sterilization and pounding of the fruit is undertaken the same way as in the soft oil process. Then the crushed pulp is heated, wrapped in sacking, and introduced into the press. Clarification of the oil is handled the same way, by heating and skimming. The process yields an oil of relatively good quality with FFA content as low as 5 percent. The press is generally operated on a family or cooperative basis, with production dependent on fair availability and several other factors.

In the 1930's, much research went into developing a small-scale mechanical mill with high efficiency, somewhere between the hand-operated press and the large-scale plantation mills. The need for this derived from the fact that traditional methods, even those involving the screw press, produced an oil of relatively low quality, had a relatively low extraction efficiency, and employed labor that would be more efficiently used in gathering fruit. Further, the large mills could only operate on plantations where there was a constant supply of palm fruit, as wild stands could not offer this guarantee. What was needed was a plant with an hourly capacity of from 1 to 2 tons of bunches, a low installation cost, and a high efficiency.

In the late 1940's and early 1950's, the United Africa Company began introducing its Pioneer oil mills, as they were called, into Eastern Nigeria. The U.A.C.'s Pioneer oil mill was designed to embody most of the technical advantages of large-scale processing and yet be small enough to be compatible with what was considered a realistic radius of fruit collection—namely, 5 miles by bush path, 7 miles by road, and 15 miles by water. It was originally designed to the cost of £ 1000 and to be owned and operated by local cooperative societies.

The usual equipment of a Pioneer oil mill included a sterilizer (autoclave) in which fruit is steamed for 16 minutes, an open unheated digestor (an enclosed set of revolving and fixed arms) which separates the pulp from the nuts, a centrifuge where the oil is open from the mesocarp, three clarification tanks for settling the sludge and other impurities from the oil, and a crude oil storage tank. The power is supplied by an upright boiler and vertical steam engine and the capacity is 12 cwt fruit (equivalent of 1 ton of bunches) per hour. The extraction efficiency is 85 percent, probably due to the low temperature of digestion and centrifuging, and yields an oil with an FFA content of below 5 percent.

The latest advance in processing technology for the small-scale peasant producer has been the hydraulic hand press. Designed by the Dutch firm Stork in 1959, the press was tested and ancillary equipment developed at the West African Institute for Oil Palm Research (WATFOR). The Stork presses had an extraction efficiency higher than the Pioneer oil mill, averaging around 86 percent and reaching a maximum 93 percent, and had a processing capacity nearly as large. In 1961 there were three major Stork mills in Eastern Nigeria, representing a capital investment of about $155,000 each. During this period there were 34 operational Pioneer oil mills, with an average investment of $50,000 per mill.

The press had a capacity of from 600 to 1,000 pounds of fruit per hour, a quantity quite large for a small-holder operation. A problem of efficient utilization soon developed of how to organize the ancillary equipment to accommodate the relatively large volume of fruit that was processed. Too, the operator using this type of press generally could not afford to invest much more capital in ancillary equipment. WATFOR therefore developed cheap equipment that could be made locally and designed for use with the hydraulic hand press.

The fruit bunches are sterilized in large (8 feet tall by 3½ feet in diameter) drums, generally three in number, which are fitted below with two boiler compartments surrounding a fire space. The stripping of the fruit from the bunch is done either by beating the bunch with wooden sticks or by using a hand-turned slotted drum. Maceration is done in the traditional way by pounding of the fruit in a large concrete mortar, which normally employs eight men. Because the fruit tends to get cold as there generally is a backlog in the pounding operation, two reheating drums are generally provided to maintain the temperature of the fruit. The pounded fruit is then fed into another reheating drum from which it is transferred to the press. The oil is then fed into a settling drum for clarification.

The extraction of the palm kernels from the fruit is not as variable as the oil. After separation of the kernel from the fiber either after loading in the traditional method or after pressing in hand-operated mill, it is common practice to return the nuts to the women who hand crack them, separating the shells from the kernels. There are available on the market, however, small nutcracking machines powered by gasoline engines. The motors turn the cracker at between 2,000 to 2,500 rpm, which will crack about 3/4 ton of nuts per hour. These are normally used with the Pioneer oil mills and can also be adapted for use with the hand-operated presses.

This processing technology has primarily been adapted to increase the efficiency of the small holders and geared to the economic and cultural conditions of the rural peasant. The need was for processing technology requiring a relatively low capital input and a relatively high labor input that could first be managed in either the village social structure or a small cooperative. Most attention in this regard was directed toward the prevailing conditions in Nigeria, as this area produced the largest exports of palm oil from wild small-holder groves. Most of the rest of the exports of palm oil from Africa were produced on commercial plantations, which required a form of processing technology adapted to a set of different conditions.

The plantation is a very well planned and highly organized operation, with the oil mill capacity generally synchronized with expected supply. The mill's capacity is adapted to three determinations:

1. Estimates of the acreage to be planted, the acreage planted each year, and the expected yield each year from initial bearing until maturity are used to determine the expected supply each year until the plantation reaches maturity. Mill capacity is increased as needed.

2. Estimates are made of the distribution of the mature production through the year, as there is a seasonal variation in areas where rainfall

shows seasonal fluctuation. Capacity is then gaged to peak production periods.

3. The form of fruit should be known, that is, the ratio of oil to kernel outturn, as this affects extraction and storage units. If presses are used in the extracting process, a certain kernel-to-pulp ratio is necessary for optimum oil recovery.

The operations in an extracting plant are broken down on a functional basis, identifying 10 sections, or stations, common to most oil mills. These are 1) sterilization of bunches, 2) stripping of bunches, 3) digestion and masking of fruit, 4) extraction of mesocarp oil, 5) clarifying the oil, 6) separation of fiber from the nut, 7) nut drying, 8) nut grading and crushing, 9) kernel separation and discarding of the shell, and 10) kernel drying and bagging.

The mills are organized around their extracting machines, either hydraulic presses or centrifuges. These machines determine the capacity of the mill, and the other machines are geared to that capacity. Oil mills are generally powered by steam engines which use the fiber, nuts, and bunch refuse as fuel. The mills produce a good quality oil and generally have an extraction efficiency of somewhere between 90 and 95 percent.

Palm industry structure in major producing countries

The palm oil mills are by necessity located at the source of production of the palm bunches. On a plantation, the mill is designed to handle the expected flow of bunches and is generally centrally located in the production area or close to a transport system. On plantations, therefore, there is generally no undercapacity or overcapacity for processing bunch production. Where mills rely on purchases of small-holder production, the capacity is not so easily gaged to potential production. Bunch flows may not be as consistent and many times the mill may operate at undercapacity. However, because of the small-holder's ability to extract oil using traditional methods, one may assume that there is sufficient capacity to handle production. Generally, though, the greater the country's mill capacity, the greater the exportable surplus.

Secondly, during the 1960's, there was a distinct trend toward domestic crushing of palm kernel production. In 1960, the only major palm kernel crushing facilities were operating in the then Democratic Republic of the Congo (now the Zaire), and minor crushing facilities in Angola and Cameroon. Since that time, Dahomey, Nigeria, Sierra Leone, and Liberia have constructed crushing plants with one also planned in the Ivory Coast. Thus, in 1960, exports of domestically crushed palm kernel oil were 14 percent of the total (oil equivalent basis) while by 1970 this share had risen to 38 percent of total oil equivalent exports.

Nigeria.—The palm oil processing structure in Nigeria is oriented toward small-holder exploitation of wild palms. Since the major share of palm oil produced is processed using traditional methods, many Government efforts have been directed toward increasing palm oil production by increasing the extraction efficiency. Most of these programs have been concentrated in the main palm belt in the Eastern Region.

The first program designed to introduce new small-holder processing techniques in Eastern Nigeria began in 1930 with the introduction of the hand-operated screw press. The program did not really take hold, however, until after World War II with increase in producer prices. In 1963, there were 3,893 screw presses in operation in the Eastern Region; many of these were destroyed during the 1967-68 civil strife, though the exact extent of damage is not known.

In 1946, the Pioneer oil mill was introduced by the Eastern Nigerian Development Corporation (ENDC). The number of mills in operation in the Eastern Region reached a peak of 96 in 1958, with less than 20 established mills outside the Eastern Region. The mills did not become widely established, however, because of the relatively high cost of the equipment and the fact that many mills were operated at undercapacity because of lack of small-holder preference to sell fruit to the mills. By 1964, the number in operation by the ENDC declined to 67, and as a result of the civil strife, the number declined to an estimated 26 in 1970.

In 1963, the Stork hydraulic press was introduced as an economic alternative to the costly Pioneer oil mill, but with superior performance over the screw presses. However, this program never got fully underway, particularly because of the 1967-68 civil strife. By 1964, there were 24 Stork presses reported to be in operation.

The contribution of these improved processing techniques was minor compared to production using traditional processing methods. For market board purchases in 1964, Purvis estimated the contributions of oil from the various processing methods (table 8). It can be assumed that all oil produced in the Pioneer oil mills and Stork presses was sold to the Eastern States Marketing Board. The screw presses, however, were included under primitive methods as this processing was still done in the village compound and yielded only moderate improvement over the traditional methods.

Table 8.—Eastern Nigeria: Contributions from alternative processing methods to total purchases of palm oil, 1964

Processing method	Sales to marketing board	
	Total	Percent Special Grade (SBO)
ENDC Pioneer oil mills . .	16,353	89.7
Private Pioneer oil mills .	9,000	95.0
Stork presses	474	100.0
Private methods	114,145	83.4
Total	139,972	84.9

Source: Purvis, M. J. The Nigerian Palm Oil Industry.

Nigeria is also quickly developing its palm kernel crushing industry. In 1966 a screw press mill just outside of Lagos, operated by Vegetable Oils (Nigeria) Ltd., began operation with a crushing capacity of 80,000 tons. A solvent extraction in Arondizuvza in East-Central State with a capacity of 35,000 tons began operation in mid-1971. Another solvent extraction plant is now under construction in Southeastern State. There are eventual plans to build plants sufficient to crush the entire production of palm kernels in Nigeria.

Republic of the Zaire.—Almost all the oil commercialized in the Zaire is produced in European-owned mills. There is some produced primarily by Zairian small-holders that is produced by smaller press operations and shipped in barrels. These mills are supplied both by production on their own plantations and by small-holder production, both from plantations and wild groves, sold to the mills. The capacity of the industry is unknown; however, it would appear that the industry in 1970 is operating at about capacity as production that is shipped in bulk has reached about the same level as attained in the peak year 1959. Almost all the processing equipment was installed prior to 1950 and is inefficient compared to the more modern mills in, for instance, the Ivory Coast. Also, there has been no additional processing capacity added during the 1960's and there is seemingly little incentive to invest in additional capacity in the future due to the increased world competition and Government controls.

The Zaire has a well-established palm kernel crushing industry, capable in recent years of crushing the total production of over 100,000 tons of kernels. Palm kernels are shipped down the Zaire River and crushed in these five mills located around Kinshasa. A meager volume is sold locally, primarily to soap manufacturers, while the major volume is shipped by rail to Matadi and exported.

Dahomey.—The processing and marketing of palm products in Dahomey is entrusted to a quasi-Government agency, SNAHDA (Societe Nationale des Huileries du Dahomey). SNAHDA now operates five palm oil mills and one palm kernel crushing plant. Two additional plants are to be built in the large plantation projects at Grand-Hinvi and Agonvz, each with a capacity of 25 tons of bunches per hour.

Table 9.—Dahomey: Location and capacity of palm processing mills

Site of mills:	Capacity (tons of bunches per year)
Avrankou (Porto-Novo area)	47,000
Ahozon (Cotonou area) . . .	35,000
Bohicon	35,000
G'bada	23,000
Mono	[1] 50,000

[1] Eventual.

Tha palm kernel crushing plant has a capacity of approximately 50,000 tons and operates at full capacity. Production of palm and palm kernel oil from these mills goes directly into export.

Ivory Coast.—Up to 1968, industrial processing of palm bunches was dependent on two private mills and three small mills, operating on the three IRHO palm research stations. However, with the progression of SODEPALM's palm planting program, mills were built near the various industrial plantations to accommodate the increased production. In total, nine are to be constructed, which in addition to the factory at Cosron, which is to remain operating, will have capacity sufficient to process total production of palm bunches in the Ivory Coast. The location of the mills and the date they either have started or will start operation are as follows:

Elobea	Jan.	1968
Tourmanquie	Jan.	1969
Irobo	Apr.	1970
Ehania	Jun.	1970
Anguededon	Dec.	1970
Bolo (Sassandra)	Jan.	1971
Bonbo		1972
Lambre.		1973
Savare de Dabon		1973

The mills are generally designed to handle approximately 40 tons of fresh fruit bunches (ffb) per hour with the potential to increase capacity to 60 tons per hour by installing an additional line. Processing costs are about $14.40 per ton of ffb.

There are also plans to construct a crushing plant to handle total production of oilseeds, including palm kernels, in the Ivory Coast. According to plans, this plant should be in operation by 1975.

Marketing

Much as production of palm oil was broken down into subsistence and commercial production, so there are different marketing systems which have been organized in response to the two different types of production. Subsistence production is oriented toward providing for food consumption needs of the producer. In the event that there is a surplus, the subsistence market provides an outlet for sales of small amounts where FFA content is not an overriding marketing criteria. Thus, the subsistence market provides a vent for surplus production for the small producer. The commercial market for palm products, however, is generally more oriented toward competing in the world market. The market system is structured more to a low FFA content oil from mill to either port or industrial utilizer at the least cost possible.

Subsistence marketing

The small-holder producer of oil generally has two alternatives in the disposition of his surplus production—to sell directly on the local market or to sell to a middleman. Generally, the marketing of the palm oil is turned over to the women of the village. The women may sell the oil on a local outdoor market. In urban areas, the markets operate daily, but in more rural regions they operate every so many days (often every fifth or sixth day). It is this type of outdoor markets that supplies almost all the domestic demand for palm oil. Also, the women may sell the oil to a middleman who travels from village to village, generally bulking oil in 4-gallon tins. This oil in turn may go through a system of middlemen where it may eventually be sold in the large urban markets or, in the case of Nigeria, may be sold to a licensed buying agent from the State marketing board.

The oil is sold in a crude form and there is generally a relatively high FFA content. The buyer generally brings his own bottle and the oil is dipped from a large tin container. Price may be haggled over but generally there is a good idea of general pricing condition on the part of both buyer and seller. In urban cases, the markets may sell some oil produced in commercial mills, though generally this is comparatively minor. Generally, the mills will sell the oil to a wholesaler and the oil will then go through a series of middlemen before being sold on the local outdoor market. There is little marketing of crude palm oil in the few retail grocery stores in the urban areas. These stores appeal primarily to the higher income group and demand here is for processed oil, which is a minor component of total consumption.

Export potential, 1980

During the 1960's, the export trends for palm products from West Africa were influenced primarily by conditions in Nigeria and the Zaire, both major exporters since before World War II. However, with the stagnation of production in the Zaire and the increasing use of what would have formerly been export supplies for domestic consumption in Nigeria, export potential for palm oil in the 1970's will shift to those countries which have undertaken large palm planting programs, particularly Dahomey, Ivory Coast, and Cameroon. Nigeria and Sierra Leone will continue to be large exporters of palm kernels or palm kernel oil, but growth in this area will also depend on the increased production in the former three countries.

During the 1960's there was a relative stagnation in the production of palm oil, discounting the sharp drop in the 1967-69 period due to the Nigerian civil war. This was a result of two offsetting trends, the increasing subsistence production of palm oil and declining commercial supplies.

Subsistence production increased nearly 3 percent annually through the period, primarily as a result of increases in domestic consumption due to population growth. This implies either that there has been harvesting of additional groves of wild palms or that supplies have been diverted from commercial channels, as in Nigeria. Through the 1970's, the increasing domestic consumption requirements will likely be met in much the same way as in the past; that is, through subsistence production dependent on the exploitation of wild groves. This, of course, is dependent on the availability of wild groves, or in some cases, small-holder plantings. To meet growing demand additional wild groves might need to be exploited, (except possibly in Nigeria), although this cannot be ascertained due to lack of data. Finally, the population growth rate should fall to 2.5 percent, resulting in the same rate of estimated growth in subsistence production.

Commercial supplies, on the other hand, dropped consistently during the 1960's, reaching the lowest level in 1967. However, during the 1970's, there will be a significant recovery in commercial supplies of palm oil, due principally to palm planting programs initiated during the 1960's. Commercial production should recover to the peak level of 1960 by 1973 and should increase to 500,000 tons by 1975. Increased domestic industrial utilization of palm oil, principally for soaps and table oils, will prevent a use in exports

at as fast a rate as production increases. Exports still should increase from the low level of 180,000 tons in 1970 to about the 1960 level of 400,000 tons by 1980.

To understand the outlook for exports of palm oil an analysis of conditions of the major exporting countries must be considered first.

Nigeria.—It appears evident that Nigeria is approaching the maximum exploitation of its wild groves. It is this source that provides 90 to 95 percent of total production of palm oil in Nigeria and is also the major source of commercial supplies. It also appears that increasing domestic consumption has eroded much of this export potential. It thus would seem evident that an increase in productivity, though an increase either in small-holder extraction rates of oil or in yields (primarily through small-holder plantings or plantations) is necessary to preserve any prospects for Nigeria as an exporter of palm oil.

It seems probable that production of palm products in Nigeria should return to their prewar level by 1973, though processing capacity other than traditional methods will not be up to the prewar normal. By 1975, commercial supplies of palm should be between 50,000 and 90,000 tons and industrial requirements should be about 30,000 tons. This would mean an export potential of between 20,000 and 60,000 tons and the best estimate is probably midway between those two estimates.

Between 1975 and 1980, the need for palm planting programs will become more serious. Significant projects will need to be implemented before 1975 if Nigeria is not to terminate exports altogether by 1980. There seems to be little progress toward revitalizing the OPRS program and the 1970-74 Development Plan seems only to concentrate on rehabilitation efforts to overcome the effects of the civil war. There has been interest by the World Bank in financing a small-holder planting scheme, but such a program is now only under initial study. Therefore, it seems likely that Nigeria will cease to be an exporter of palm oil by 1980.

Nigeria in the 1970's will continue to be the world's largest exporter of palm kernels, with an increasing percentage of exports as palm kernel oil as crushing capacity increases. There is a small industrial demand for palm kernel oil in the country, particularly when palm oil supplies are short; however, local demand should only be about 5,000 to 7,000 tons by 1980. Palm kernel production should stabilize around 440,000 tons, or exports of about 200,000 tons of palm kernel oil, through 1980.

Republic of the Zaire.—Although in the Republic of the Zaire the more efficient plantation system is used for production for exports of palm oil, the relatively advanced age structure of trees—most were planted in the 1950's, with only minor plantings in the 1960's—has caused production to stagnate at a level of around 170,000 tons. Furthermore, there appears to be little incentive among the plantation systems, most of which are European owned, to invest in substantial new plantings. This is primarily due to increasing costs due to governmental controls—taxes, minimum wage rates, fixed domestic prices: the high transport costs from the major producing areas; and apparent labor shortages. It seems apparent that the plantations are trying to run their mills at capacity and in that respect are planning minor replanting programs in order to maintain an optimum flow of bunches.

In the face of a relatively stagnant production level there has been a consistent increase in domestic industrial requirements since 1966 on the order of 5,000 tons. This has resulted in a declining export level since 1968, from 141,000 tons to 112,000 tons in 1971. Industrial utilization, principally in soaps and table oils, has grown from 35,500 to 55,000 tons. By 1975, this level should reach approximately 70,000 tons, with potential exports of only 90,000 to 100,000 tons. By 1980, exports will decline to a level of around 70,000 tons. This assumes that producers in the Zaire can remain competitive in the world market in the face of the higher production costs existing in the major producing areas—in Kwilo because of the dependence on exploitation of wild groves and in the production areas on the upper reaches of the Zaire River because of the large transport cost to port. The industry is also one of the oldest in operation today, with relatively outdated mills and groves that are relatively advanced in age.

Dahomey.—In 1971, Dahomey completed its large palm planting program with 27,000 hectares being planted in three main plantations. Between 1970 and 1975 most of this area will come into bearing, with palm oil production reaching an estimated 40,000 tons by 1975. This oil goes directly into export through the bulk facilities in Cotonou, as there is no industrial utilization of palm oil in Dahomey.

There are additional plans for projects covering 6,000 hectares to be planted between 1973 and 1975. These projects will attempt to use dry-farming techniques, keeping all vegetation cleared beneath the palm to conserve water in the ground during the dry season, and thus raise yields to about 12 tons of bunches or 2.5 tons of oil per hectare. Thus by 1980, exports of palm oil should reach approximately 60,000 tons and exports of palm kernels should approach 65,000 to 70,000 tons.

Ivory Coast.—During the 1970's, the Ivory Coast will become the largest exporter of palm oil from the

African Continent, due to the large planting program undertaken during the 1960's. This program will be continued during the 1970's except that the planting program will be concentrated in the southwest area of the country, west of the Lassandra River, whereas the present program has been developed primarily in the eastern area of the country, concentrating around the port city of Abidjan. By 1970, 67,600 hectares had been planted to high-yielding palms.

Production of palm oil is expected to increase proportionately reaching an estimated 177,000 tons by 1975 and 250,000 tons by 1980. However, due to the Ivory Coast's fast-growing economy, it is expected that requirements for processed oil will rise in response to increased incomes. In this respect, the major oil refiner in the Ivory Coast is sharply increasing its palm oil refining capacity with a view to supplying an expanding market with soaps and refined table oils. In 1971, the palm oil refining capacity in the Ivory Coast was approximately 24,000 tons; by 1975 this capacity should increase to 60,000 tons. Thus, exports of palm oil would be around 115,000 tons by 1975 and 175,000 tons by 1980.

Palm kernel production should reach 54,000 tons by 1975 and 75,000 tons by 1980. Palm kernel crushing facilities are expected to be in operation by 1975, therefore implying that production will be exported as oil. There appears to be minor potential for any local consumption of palm kernel oil.

Cameroon.—Between 1967 and 1972, 22,300 hectares will be planted to high-yielding oil palms in Cameroon. Production of palm oil from these groves should reach nearly 33,000 tons by 1975, with total commercial production reaching an estimated 40,000 tons. Exports of palm oil will probably be in the neighborhood of 35,000 tons by 1975 and 60,000 tons by 1980.

Commercial production of palm oil in West Africa is expected to rise to 537,000 tons by 1975 and to 655,000 tons by 1980, from the low level of 286,000 tons in 1970. Industrial utilization of palm oil is expected to more than double as development and rising incomes create larger demands for processed palm oil. Exports of palm oil from West Africa, nevertheless, will expand on the average of about 8.3 percent per year through the 1970's; however the rate of growth will be faster through 1975 and slowing down thereafter. Exports are projected to reach 350,000 tons by 1975 and 400,000 tons by 1980, compared to 181,000 tons in 1970.

This increase will come during a period of rapid expansion in exports from Malaysia and Indonesia, creating an increased competition for markets. Exports of palm oil from West Africa (except from Nigeria) will continue to find their major market in the Common Market primarily because of the exemption from the import duty on edible palm oil imports for the 18 Associated African States, which includes the major African exporters, and also because of their historical trade patterns which date back to the colonial period.

Appendix

Table A-1.–Palm oil: Production[1] by major producing countries in Africa, annual, 1960-71
(1,000 metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971[2]
Angola	22	24	25	29	30	27	27	30	25	25	25	25
Cameroon	27	26	24	25	29	34	35	31	32	33	36	37
Dahoney	36	35	39	44	30	31	32	36	38	42	44	48
Guinea, Republic of	28	22	24	28	26	31	35	38	41	44	44	44
Ghana	40	37	41	43	44	39	46	58	56	57	58	60
Ivory Coast	20	22	23	24	28	[3] 27	[3] 27	[3] 30	[3] 31	[3] 37	[3] 59	[3] 80
Liberia	12	11	11	11	12	15	15	18	16	15	17	18
Nigeria	545	538	504	536	516	574	551	320	336	418	488	500
Sierra Leone	36	36	37	37	38	38	39	40	40	41	41	42
Togo	18	13	14	16	18	18	19	16	16	21	21	21
Zaire	234	218	223	227	216	176	172	194	230	225	228	230
Total	1,018	982	965	1,020	987	1,010	998	811	861	958	1,061	1,105

[1] Commercial production unless otherwise specified.
[2] Estimated.
[3] Estates only.

Table A-2.–Palm oil: Production in major producing countries in Africa, by economic sectors, 1960-70
(Metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Angola:											
Commercial	18.0	19.6	20.1	23.7	24.8	21.6	21.5	22.5	18.7	17.9	18.3
Subsistence	4.0	4.5	4.8	5.3	5.5	5.7	5.5	7.9	6.1	7.1	6.7
Cameroon:											
Commercial	8.3	9.6	7.1	6.1	8.9	13.0	15.0	9.9	7.3	6.3	8.9
Subsistence	19.1	16.0	16.4	18.9	19.7	21.4	20.0	21.0	25.0	26.2	27.0
Congo (Brazzaville):											
Commercial	3.5	3.4	3.9	3.2	2.6	2.1	.8	.4	--	--	--
Subsistence	4.6	4.2	5.7	8.9	5.4	4.9	4.2	5.8	5.0	4.5	5.0
Dahomey:											
Commercial	16.0	11.1	9.3	9.2	12.7	13.3	9.9	8.5	10.1	12.9	14.7
Subsistence	20.0	23.9	29.9	34.6	17.8	17.6	22.0	27.3	28.0	28.7	29.5
Guinea, Equatorial:											
Commercial	2.7	2.8	3.2	2.8	2.8	3.8	2.7	3.0	2.5	2.5	2.5
Subsistence	2.9	3.0	3.0	3.1	3.2	3.2	3.3	3.3	3.4	3.4	3.5
Guinea, Portuguese:											
Commerical	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
Subsistence	7.8	7.8	7.8	7.9	7.9	7.9	7.9	7.9	7.9	8.0	8.0
Guinea, Republic of:											
Commercial	--	--	--	--	--	--	--	--	--	--	--
Subsistence	27.6	22.4	24.2	27.6	25.8	31.3	35.0	37.5	41.3	43.8	43.8
Gabon:											
Commercial	--	.4	--	.1	.4	1.1	.9	1.0	1.4	.9	.5
Subsistence	5.4	5.4	5.4	5.5	5.5	5.5	5.6	5.7	5.8	5.8	5.9
Gambia:											
Commercial	--	--	--	--	--	--	--	--	--	--	--
Subsistence	2.1	2.0	2.3	2.2	1.7	1.9	2.4	2.9	2.5	2.5	3.4
Ghana:											
Commercial	.5	.7	1.0	1.3	1.5	1.6	1.9	2.0	2.1	2.3	2.5
Subsistence	35.0	36.0	40.0	42.0	43.0	37.0	44.0	56.0	54.0	55.0	55.0
Ivory Coast:											
Commercial	6.0	6.7	6.4	8.3	11.0	9.8	9.7	12.8	14.7	21.4	42.5
Subsistence	14.4	15.6	16.6	16.2	17.0	17.0	17.0	17.0	16.5	16.0	16.0
Liberia:											
Commercial	--	--	--	--	--	--	--	--	--	.1	.1
Subsistence	12.0	11.0	10.8	11.0	12.0	15.0	15.0	17.6	15.8	14.5	16.7
Nigeria:											
Commercial	190.1	173.4	128.5	149.0	147.9	164.2	158.0	32.0	4.2	22.6	25.0
Subsistence	355.0	365.0	376.0	387.0	398.0	410.0	422.0	288.0	332.0	395.0	463.0
Sao Tome and Principe:											
Commercial	1.2	1.1	.8	1.0	.6	.9	.7	.5	.4	.2	.2
Subsistence	.8	.8	.8	.9	.9	.9	.9	.9	1.0	1.0	1.0

Table A-2.–Palm oil: Production in major producing countries in Africa, by economic sectors, 1960-70–Continued
(Metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Sierra Leone:											
Commercial	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.8
Subsistence	35.2	35.7	36.2	36.8	37.3	37.9	38.5	39.0	39.6	40.2	40.8
Togo:											
Commercial	.7	.9	.3	.2	.1	(1)	.2	.2	(1)	.1	.1
Subsistence	17.0	13.4	13.7	15.9	18.0	18.4	18.9	16.1	16.1	20.4	20.9
Zaire:											
Commercial	196.8	178.6	182.1	183.9	171.2	129.1	123.1	142.6	176.7	169.8	170.6
Subsistence	37.0	39.0	41.0	43.0	45.0	47.0	49.0	51.0	53.0	55.0	57.0
Total Africa:											
Commercial	444.3	408.9	363.3	389.4	385.1	361.1	345.0	236.0	238.7	257.6	286.5
Subsistence	599.9	605.7	634.6	666.8	663.7	682.7	711.2	604.9	653.0	727.1	803.2
Grand total	1044.2	1014.6	997.9	1056.2	1048.8	1043.8	1056.2	840.9	891.7	984.7	1089.7

[1] Less than 0.05 ton.

Table A-3.–Palm kernels: Production in major producing countries in Africa, 1960-70
(1,000 metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Angola[1]	7.5	17.3	17.2	21.4	21.3	17.1	16.7	19.9	13.8	14.4	13.5
Cameroon[2]	26.6	26.1	38.9	38.3	41.7	48.2	36.8	49.6	50.9	52.0	56.0
Congo (Brazzaville)[1]	6.5	6.1	7.7	9.7	6.4	5.6	4.0	5.0	4.0	2.8	2.5
Dahomey	61.3	42.9	36.7	45.2	57.0	53.3	50.0	39.9	57.0	65.3	[4] 60.0
Gambia[1]	1.7	1.6	1.9	1.7	1.3	1.5	1.9	2.3	2.0	2.0	2.8
Ghana[2]	12.0	12.5	13.0	13.5	14.0	22.1	27.0	35.0	34.0	34.0	37.0
Guinea, Equatorial	4.0	4.0	2.9	2.6	3.4	2.2	1.6	1.7	2.0	2.0	2.0
Guinea, Portuguese[1]	6.8	16.7	17.6	12.4	9.1	9.0	8.0	10.2	8.0	12.0	6.8
Guinea, Republic of	23.0	18.7	20.2	23.0	21.5	25.0	28.0	30.0	33.0	35.0	35.0
Ivory Coast	17.4	13.5	14.0	15.6	15.0	16.5	13.2	13.2	13.9	15.4	19.1
Liberia[1]	15.2	12.9	8.6	6.0	6.9	11.6	11.9	14.1	12.6	11.7	13.4
Nigeria[5]	430.0	437.2	368.0	420.3	407.9	461.5	470.0	250.0	225.0	260.0	295.5
Sao Tome and Principe[1]	4.4	4.2	4.3	3.6	3.5	3.5	3.5	3.3	2.7	2.6	2.5
Senegal[1]	4.2	4.9	5.6	4.0	4.3	3.8	3.3	3.9	4.0	3.3	7.0
Sierra Leone[1]	55.4	58.7	62.0	53.6	53.0	50.1	55.5	57.0	53.0	52.2	56.6
Togo[1]	14.2	11.1	10.4	12.7	14.5	15.3	16.6	13.0	12.9	16.0	17.1
Zaire[3]	142.2	127.0	112.6	84.7	93.5	77.1	78.9	93.1	105.3	97.5	107.1
Total	832.4	815.4	741.6	768.3	774.3	823.4	826.9	641.2	634.1	678.2	733.9

[1] Exports. [2] Source: Food and Agricultural Organization of the United Nations. [3] Kernel equivalent of palm kernel oil production plus kernel exports.
[4] Estimate. [5] Marketing Board purchases.

Table A-4.–Palm oil: Exports by major exporting countries in Africa, annual 1960-70
(Metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Angola	13,004	14,641	15,087	16,733	17,809	14,612	14,493	15,486	11,715	10,913	11,309
Cameroon	8,258	9,605	7,145	6,068	8,902	12,955	15,019	9,939	7,330	6,301	[1] 8,900
Congo (Brazzaville)	3,533	3,356	3,887	3,164	2,624	2,132	769	431	0	0	[1] 0
Dahomey	16,014	11,050	9,292	9,242	12,707	13,256	9,907	8,515	10,067	12,483	[1] 14,000
Gabon	0	399	0	50	384	1,135	881	1,032	1,390	929	[1] 500
Guinea, Equatorial	2,671	2,826	3,205	2,750	2,804	3,757	2,668	3,048	[1] 3,000	[1] 2,500	[1] 2,500
Guinea, Portuguese	192	34	47	75	0	0	[1] 85	141	59	[1] 100	[1] 100
Ivory Coast	471	442	1,134	439	869	1,208	680	513	405	2,025	12,542
Nigeria	186,312	167,242	120,579	127,706	136,384	152,422	146,150	16,731	3,395	8,123	7,643
Sao Tome and Principe	1,230	1,090	823	974	624	871	680	548	381	246	230
Togo	681	866	304	171	124	13	155	233	36	60	147
Zaire	168.900	154,386	151,054	142,994	123,921	78,587	83,883	115,437	141,216	124,995	123,473
Total	401,266	365,937	312,557	310,366	307,152	280,948	275,370	172,054	178,994	168,675	181,344

[1] Estimated from import data.

Table A-5.–Palm kernel oil: Exports by major trading countries in Africa, annual 1960-70
(Metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Angola	1,091	3,350	2,621	1,578	2,152	1,303	1,212	1,457	705	908	455
Cameroon	472	337	808	603	1,469	1,082	923	757	325	872	1,000
Dahomey	--	--	--	--	--	16,691	11,698	16,736	22,715	24,600	22,000
Ivory Coast	--	--	--	--	--	122	181	2,426	1,864	804	1,000
Nigeria	1	--	86	3,204	877	964	32,602	37,787	27,263	37,278	32,763
Sierra Leone	--	--	--	--	--	--	--	4,456	1,460	--	--
Zaire	52,547	49,987	41,896	31,962	44,283	31,262	32,275	41,778	44,814	41,929	50,251

Table A-6.–Palm kernels: Exports by major training countries in Africa, annual 1960-70
(Metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Angola	5,181	10,214	11,610	18,001	16,693	14,317	14,105	16,790	12,349	12,489	12,488
Cameroon	20,889	19,444	16,831	18,476	19,920	24,501	17,843	19,543	27,323	22,998	22,700
Central African Republic	1,185	969	912	1,230	1,104	1,382	1,286	889	748	221	300
Congo (Brazzaville)	6,514	6,102	7,717	9,655	6,400	5,603	4,004	4,992	4,003	2,800	2,500
Dahomey	61,274	48,842	43,901	50,557	56,159	16,743	5,762	3,971	7,153	8,500	11,000
Gabon	--	--	--	--	206	385	288	263	445	229	300
Gambia	1,652	1,613	1,864	1,730	1,332	1,541	1,904	2,346	1,972	1,965	2,751
Ghana	3,098	1,795	799	571	1,016	406	--	610	107	636	1
Guinea, Equatorial	3,961	4,039	2,906	2,577	3,375	2,184	1,594	1,707	2,000	2,000	2,000
Guinea, Portuguese	6,798	16,651	17,638	12,356	9,076	8,995	8,031	10,242	8,031	12,000	6,800
Guinea, Republic of	22,968	18,653	20,185	23,000	21,500	12,000	12,000	15,124	16,100	15,000	15,000
Ivory Coast	16,354	12,487	10,696	10,441	12,822	14,861	9,385	10,137	8,675	12,563	18,132
Liberia	15,221	12,891	8,601	5,984	6,940	11,572	11,933	14,089	12,595	11,659	13,429
Nigeria	424,923	417,239	372,532	404,720	400,534	422,196	400,298	165,119	161,574	178,961	185,326
Sao Tome and Principe	4,447	4,248	4,262	3,588	3,508	3,540	3,532	3,315	2,714	2,581	2,488
Senegal	4,181	4,914	5,587	4,000	4,316	3,757	3,266	3,859	4,005	3,273	7,000
Sierra Leone	55,399	58,690	61,965	53,637	52,998	50,067	55,531	21,799	65,300	49,283	59,209
Togo	14,181	11,140	10,400	12,748	14,477	15,316	16,601	13,000	12,876	15,972	17,050
Zaire	20,500	12,764	18,851	2,845	1,130	0	0	4,100	2,200	0	0

Table A-7.–Palm oil: Imports into specified countries, annual 1960-71 [1]
(1,000 metric tons)

Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970[2]	Est. 1971[3]
Belgium-Luxembourg	42	43	37	37	42	28	27	28	28	22	25	25
France	33	32	33	36	40	37	41	42	35	35	41	48
Germany, West	73	78	79	93	111	103	115	99	126	132	116	150
Italy	31	25	26	28	29	32	33	36	37	53	43	49
Netherlands	87	89	54	68	74	65	69	65	71	77	89	124
Total EC	266	267	229	262	296	265	285	270	297	319	314	396
Canada	8	24	14	12	6	9	12	10	8	16	12	12
Denmark	2	6	5	3	3	1	1	1	1	4	5	--
India	35	34	30	37	36	7	11	8	1	([4])	([4])	--
Iraq	19	19	19	28	29	50	36	52	54	58	62	--
Ireland	4	4	4	3	5	3	5	3	2	3	4	--
Ivory Coast	2	5	6	4	([4])	1	4	1	2	1	1	--
Japan	13	15	14	17	18	16	20	22	28	42	40	40
Kenya	([4])	2	2	3	3	5	4	2	6	12	7	--
Philippines	5	4	5	5	7	6	6	7	6	8	5	--
Portugal	16	15	11	14	16	14	16	16	14	18	19	20
Spain	([4])	([4])	([4])	([4])	1	([4])	2	1	2	7	4	--
Sweden	3	1	2	2	2	2	2	2	3	3	5	--
United Kingdom	178	163	113	114	116	117	150	99	109	139	162	225
United States	21	25	16	11	3	3	34	29	47	72	64	--
Total	572	584	470	515	541	499	588	523	580	702	704	--

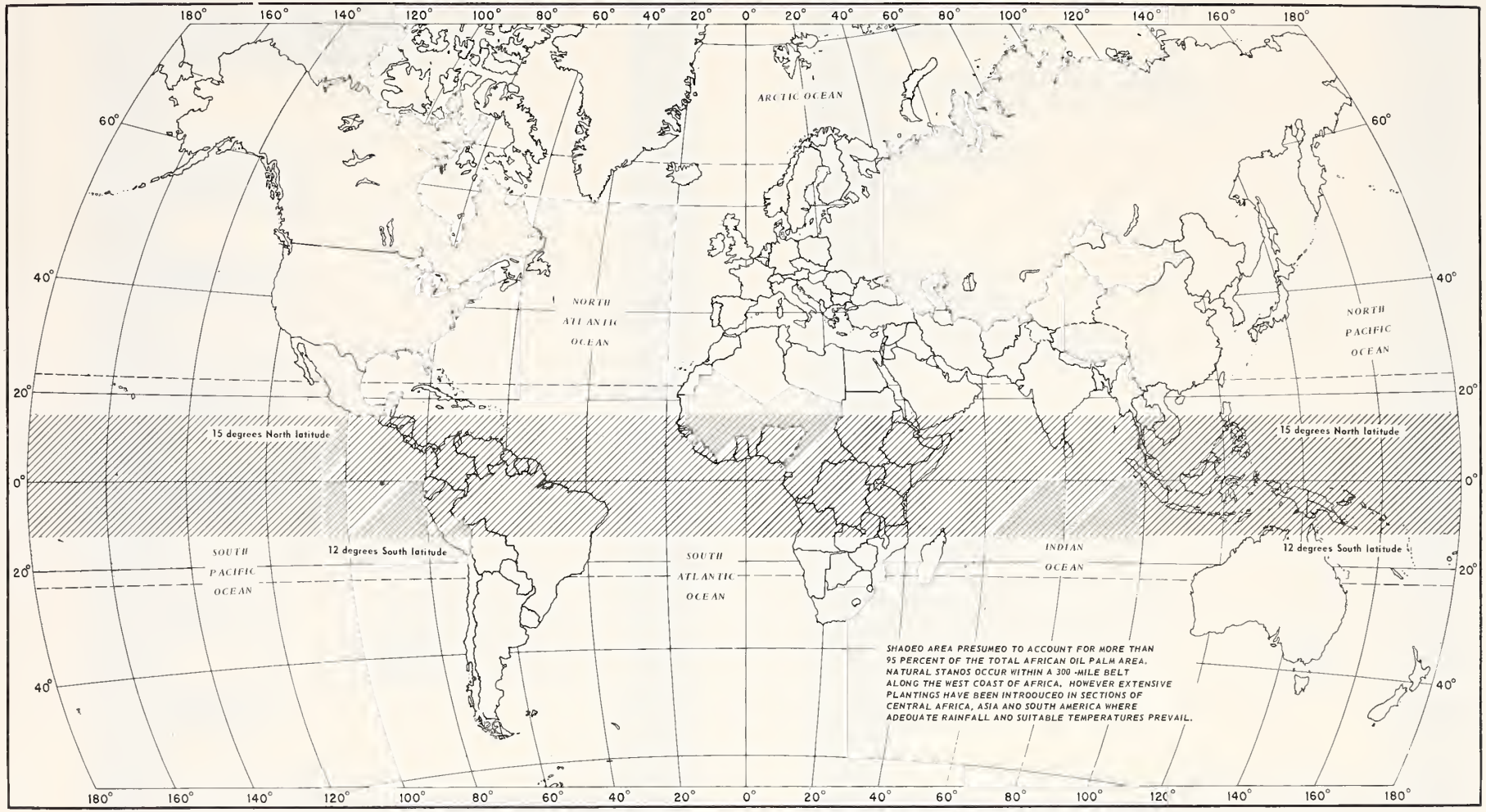
[1] Gross imports.
[2] Preliminary.
[3] Foods and Agricultural Organization of the United Nations, February 1972.
[4] Less than 500 tons.

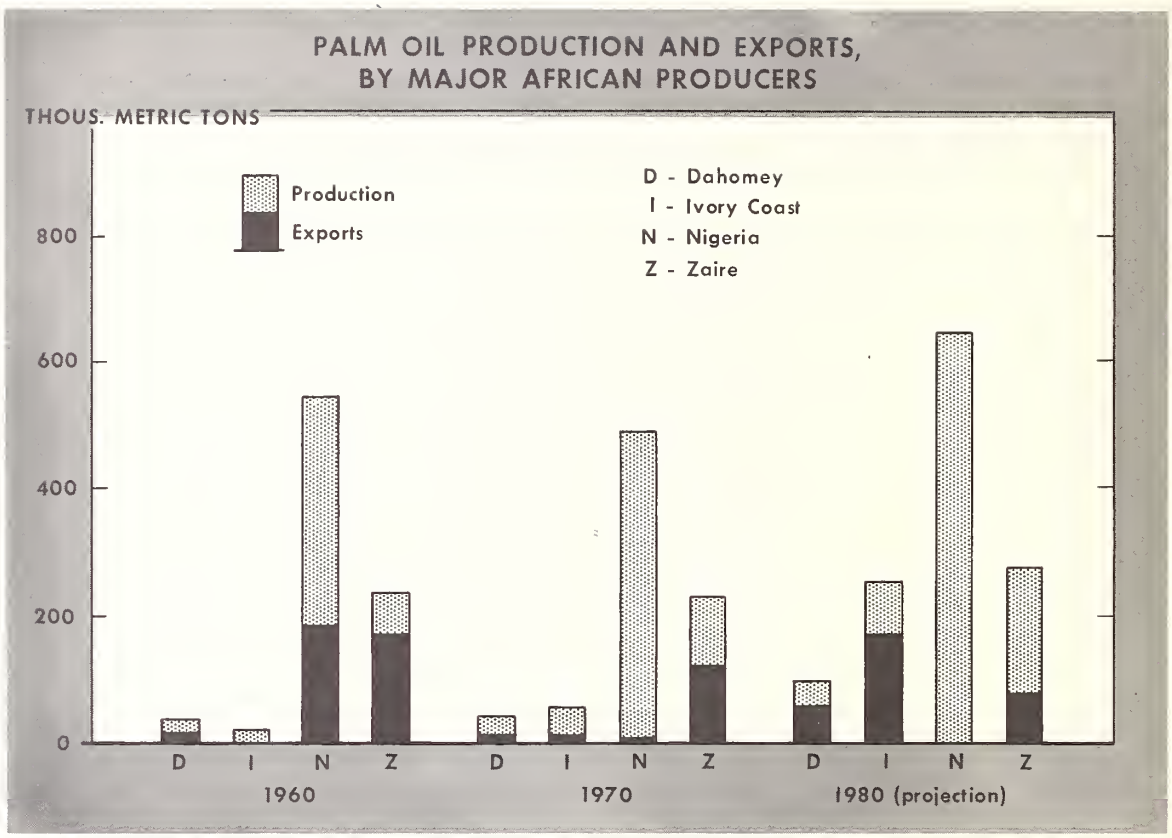
Table A-8.–Europe: Origin of palm oil imports in selected European countries, annual 1960-70
(Metric tons)

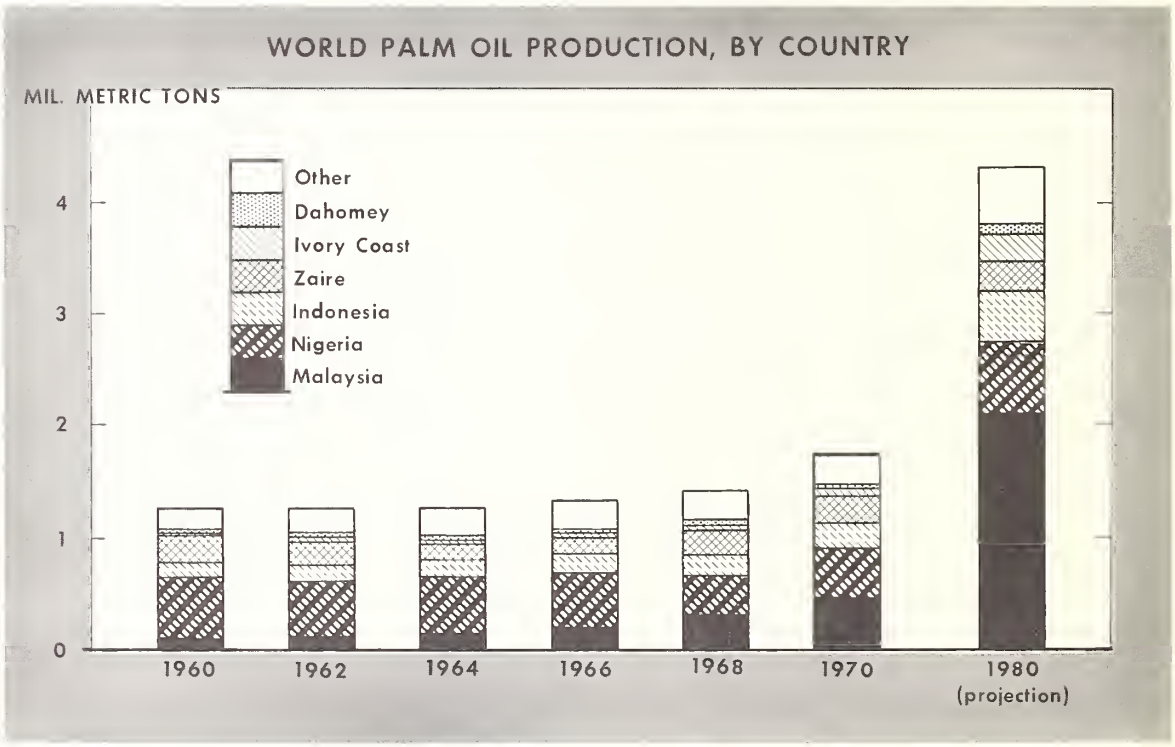
Country	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Belgium-Luxembourg:											
Africa	37,546	33,355	33,056	32,253	28,667	16,573	9,241	12,486	11,846	8,166	10,450
Asia	--	5,548	--	--	12,369	8,325	12,503	11,820	11,801	10,976	11,607
Other	4,875	3,615	3,530	5,049	1,102	2,754	5,211	3,707	4,129	3,124	3,438
France:											
Africa	30,650	28,957	26,724	50,631	32,808	30,846	32,655	33,907	27,376	24,690	27,592
Asia	447	--	--	--	822	--	757	1,160	2,613	4,972	6,863
Other	2,362	3,078	6,067	5,669	6,233	5,884	7,535	7,038	5,094	5,509	6,609
Italy:											
Africa	19,278	14,008	[1] 16,000	18,233	16,522	18,256	23,980	24,894	24,647	31,629	28,314
Asia	10,771	9,417	[1] 8,000	7,384	9,632	13,770	9,030	10,019	9,778	19,939	11,431
Other	968	1,330	[1] 1,644	2,387	780	20	108	1,398	2,647	1,793	3,114
Netherlands:											
Africa	[1] 35,304	[1] 45,385	[1] 16,499	[1] 26,043	31,697	22,204	25,256	20,422	20,463	27,649	34,043
Asia	[1] 51,000	[1] 41,000	[1] 35,000	[1] 40,000	41,049	40,268	43,622	43,265	49,897	49,542	51,588
Other	[1] 500	[1] 2,600	[1] 3,000	[1] 2,400	1,037	2,077	110	877	723	254	3,711
West Germany:											
Africa	55,746	53,349	59,753	65,149	81,403	63,942	60,594	52,113	70,722	63,191	59,954
Asia	15,845	22,963	18,431	26,067	28,213	37,865	53,571	46,213	51,157	61,649	49,022
Other	1,029	1,427	804	1,312	1,353	758	686	774	5,303	7,643	6,951
Total EEC:											
Africa	178,524	175,054	152,032	172,309	191,117	151,821	151,726	143,882	155,054	155,325	160,353
Asia	78,063	78,728	61,431	73,401	92,085	100,228	111,483	112,477	125,246	147,078	130,491
Other	9,734	12,050	15,045	16,877	10,505	11,493	13,650	13,794	17,896	18,323	23,823
United Kingdom:											
Africa	139,146	128,101	80,330	70,864	65,945	64,113	88,989	11,998	1,321	7,200	3,434
Asia	38,385	35,289	32,407	42,743	49,892	53,007	61,107	84,604	106,742	131,514	157,496
Other	2	46	159	130	43	70	207	2,109	682	693	1,505
Portugal:											
Africa	15,574	14,722	[1] 11,061	13,614	16,185	13,780	15,928	13,483	8,815	11,240	9,565
Asia	--	--	--	--	--	--	--	2,121	5,012	6,577	9,549
Other	101	--	--	15	--	8	--	3	423	6	--
Denmark:											
Africa	1,860	5,368	4,864	3,187	2,545	1,177	407	619	--	453	--
Asia	--	--	289	--	410	--	230	722	1,157	3,089	4,533
Other	84	425	1	16	153	12	40	67	20	1	28
Sweden:											
Africa	2,350	1,124	1,127	201	795	1,167	60	--	--	--	--
Asia	1,042	40	428	1,697	1,012	984	2,125	1,796	2,773	2,545	[1] 4,100
Other	47	96	50	116	52	93	14	27	213	928	[1] 497

[1] Breakout by country not available, estimated from country of origin export data.

LIMITS OF NATURAL HABITAT SUITED TO CULTIVATION OF AFRICAN OIL PALM




PALM OIL PRODUCTION AND EXPORTS,
BY MAJOR AFRICAN PRODUCERS
THOUS. METRIC TONS
Production
Exports
D - Dahomey
I - Ivory Coast
N - Nigeria
Z - Zaire
800
600
400
200
0
D I N Z D I N Z D I N Z
1960
1970
1980 (projection)


WORLD PALM OIL PRODUCTION, BY COUNTRY
MIL. METRIC TONS
Other
Dahomey
Ivory Coast
Zaire
Indonesia
Nigeria
Malaysia
4
3
2
1
0
1960
1962
1964
1966
1968
1970
1980
(projection)

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